A MACHINE KNITTER'S GUIDE TO CREATING FABRICS
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JACQUARD · LACE · INTARSIA · RIPPLE AND MORE
SUSANNA E. LEWIS
JULIA WEISSMAN
Lewis & Weissman
Lark Books

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A MACHINE KNITTER'S GUIDE TO CREATING FABRICS
Jacquard, Lace, Intarsia, Ripple, and More

Here, in a single volume, are all the facts and inspiration a creative knitter needs in order to design magnificent fabrics on a knitting machine! More than 350 fabric swatches were knitted and photographed especially for this book, many of them the author's own invention. Complete knitting instructions accompany each swatch. Hundreds of diagrams show cam settings, needle set-ups, and stitch formations. More than 90 graphed designs provide a wealth of ideas for patterned and multi-color knitting.

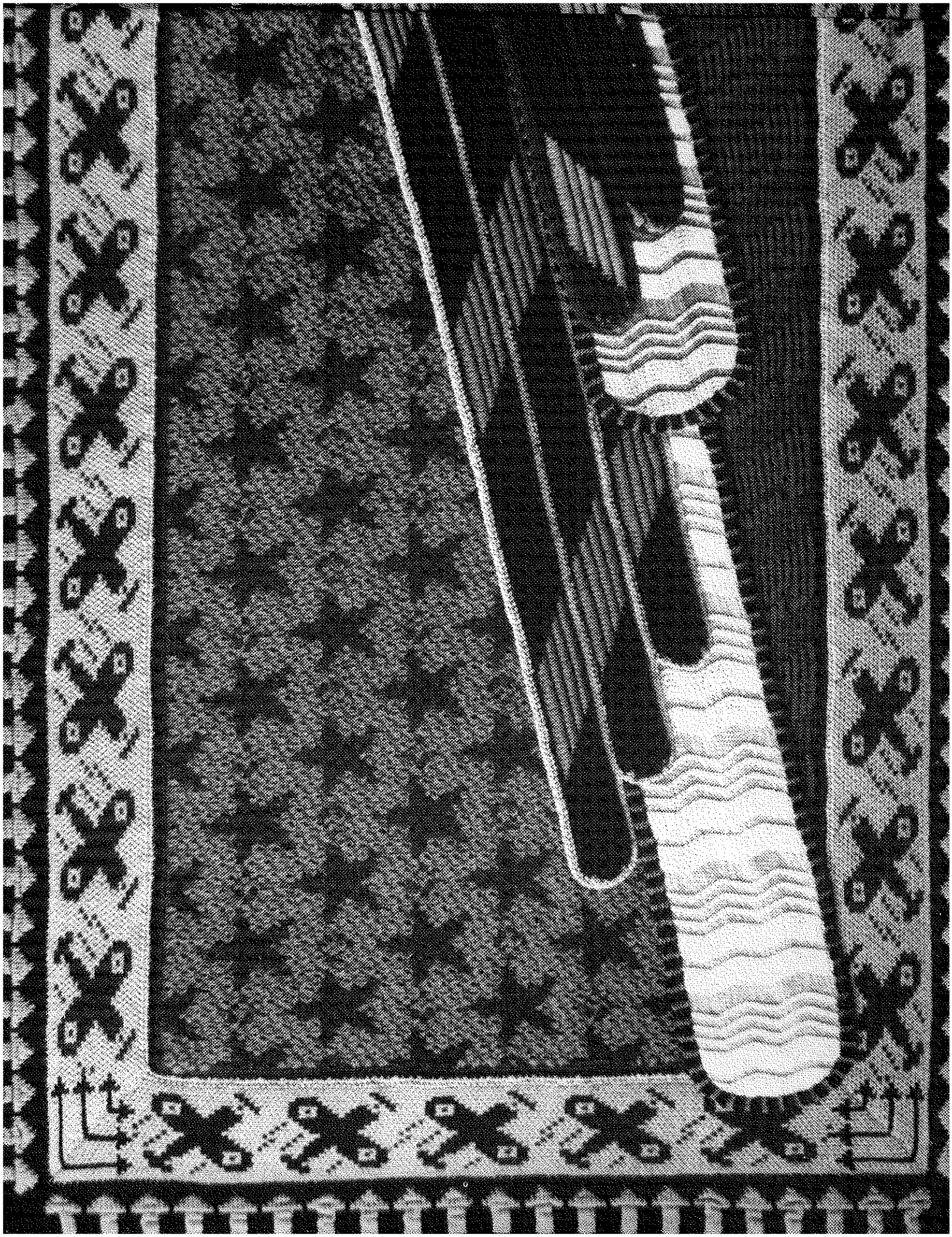
The authors chose several popular knitting machines to knit the examples shown in this book: Brother, Knitking, Singer, Studio, Passap, and Superba. The instructions are cross-referenced for all the machines, and are written generically so the fabrics presented here can be made on any other knitting machine as well.

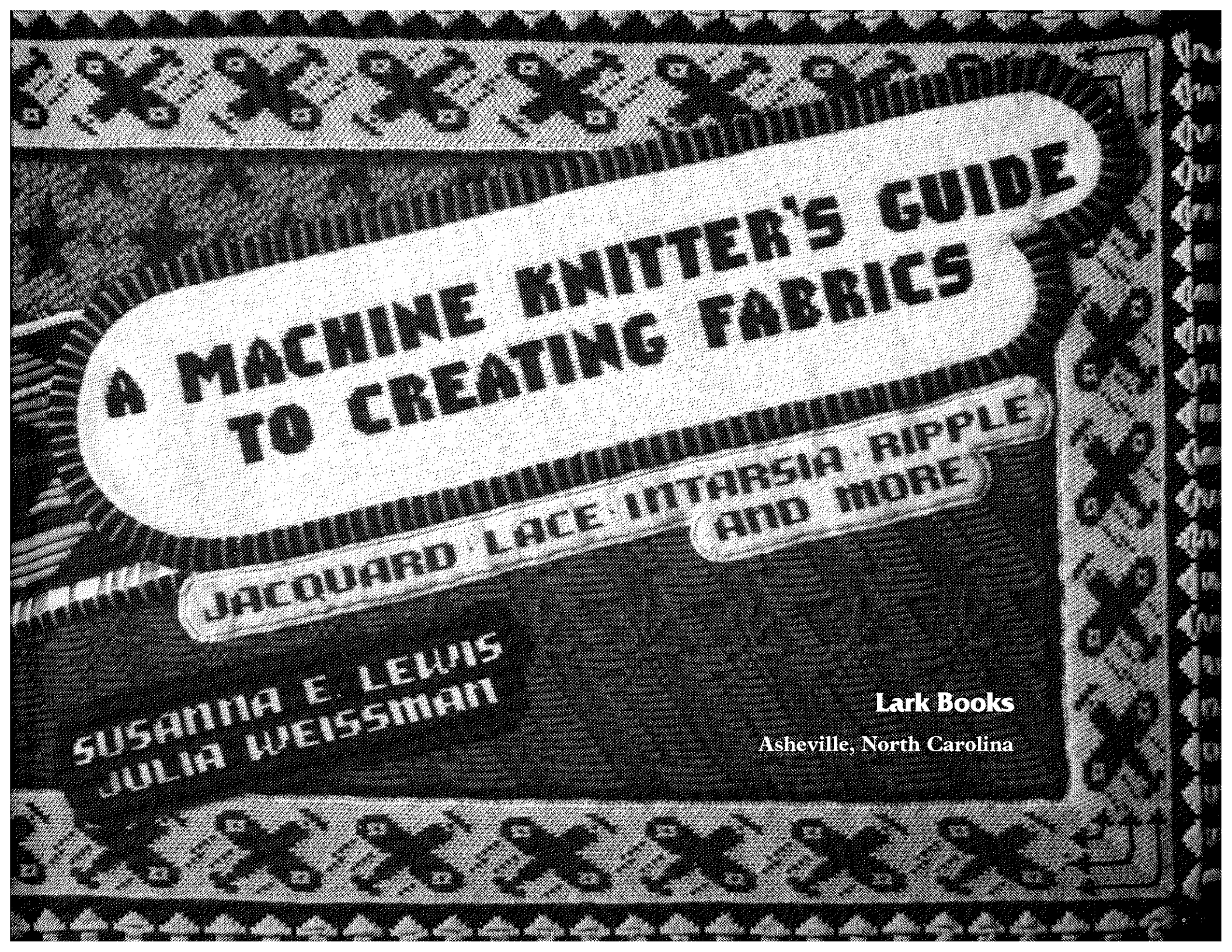
The first chapters include reference material invaluable to any knitter: the functions of various machine accessories and auxiliary carriages, the mechanics of punchcard knitting, a thorough glossary of machine knitting terms, and complete instructions for knitting basic fabrics from which unlimited variations can be designed.

The authors spent more than five years developing and writing this important book. It would be difficult to imagine a knitted fabric that's not included, but that's exactly the author's intent. *A Machine Knitter's Guide* is meant to be just a starting point, a complete sourcebook that enables the knitter to begin creating original and distinctive fabrics.

Lark Books
Asheville, North Carolina

A Machine Knitter's Guide to Creating Fabrics

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The banner shown on the jacket and title page was designed and executed by Susanna Lewis. Detailed photographs of the patterns and instructions for knitting them are found on the following pages:

Title and authors' names: page 65, plated backing.

Chevron pattern: page 89, basic pin tuck in two-color jacquard.

Zigzag rib pattern: page 122, embossed racked rib on stockinette backing, with plating.

Star pattern: page 59, nopped face with 2x2 selection on backing.

Lightning bolt pattern: page 91, embossed pin tuck, jacquard Pattern 6.

Airplane pattern: page 47, bird's-eye backing, jacquard Pattern 8.

Arrow border pattern: page 97, two-color raised blister.

While a great deal of effort has been spent in checking and testing of material in this book, the authors cannot accept responsibility for loss or damage to materials or equipment which result from errors in printing, misinterpretation by the reader, or faulty adjustment of the knitter's machine and accessories.

For all knitters and fiberists of the past and present, whose love for their craft has inspired the continual evolution of skills and techniques, and whose use of the craft helps us see beauty and meaning in the continual evolution of life. They provide the heritage and legacy for the knitters and fiberists of the future, so that they too may experience the thrill and joy of discovery, understanding and creation; in turn to promote communication and understanding in oneself, and between people and cultures worldwide.

Human beings are blessed with ten strong, amazingly dextrous fingers and a world filled with raw material from which can be fashioned almost anything that may be desired. But . . . it is obvious that hands, even though they are guided by an ingenious brain, must have tools to accomplish much . . . . There can be artistry in the use of . . . any tool . . . tools (are) extensions of hand and brain.

Alfred P. Morgan
Woodworking Tools and How To Use Them
1948

A hand knitting machine is a tool.

Susanna Lewis
Julia Weissman

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PLEASE READ THIS FIRST

How-to books like this one are a special way of teaching. Since the instructor is speaking through the pages of the book, rather than in person, communication is strictly one-way. For those who feel they must see and hear the instructor go through each process, this way of learning can have limitations, yet it can be a very positive experience for those who value proceeding at their own pace and like to go off on tangents.

To gain the most from this particular how-to book, a knitter should study each new concept carefully, one step at a time, and follow and *practice* the instructions step by step. Practice is the only way to learn and perfect a craft, even with accompanying classroom instruction or demonstration. The most descriptive words accompanied by the most explicit illustrations simply won't gel into total understanding until your hands join your eyes and mind in the adventure.

By all means, browse through the following pages to get a visual concept of what you can learn. When you are ready to start, *read the Introduction first,* since it explains the scope, format, point of view, and approach to the information in this book. Then, take one section of a chapter at a time, read its explanatory text, sit down at your machine with the book, notepad, and pencil within easy reach, and begin your new adventures in machine knitting.

HOW THIS BOOK CAME TO BE

Late in the year 1971, armed with money for Christmas shopping, I was looking in windows along Fifth Avenue when I saw it, in a shop window. It was a sophisticated assemblage of pink plastic and shiny metal, and it looked serious, like it meant business. The lady who was feeding yarn into it by moving a box across it seemed to know what she was doing, since out from underneath it was slowly appearing a piece of—knitting?

Well, to make a long story short, I couldn't believe it. I was a fiber artist in search of a technique, and at last I had found it. After lying awake most of that night, I took my Christmas shopping money to the store the next day and purchased my first knitting machine.

I wanted to make tapestries. I had already delved quite deeply into quiltmaking, fabric applique, and various surface design techniques as possible media for my tapestries. I loved them all but they weren't enough. I wanted to make designs in the fabric, but I wanted to make the fabric, too. So I tried knitting, crochet, lacemaking, macrame, and other non-loom techniques. Those techniques were wonderful and I loved every moment spent feeling, building, and enjoying my fabric, but I was frustrated—the ideas and feelings that I wanted to express overwhelmed my ability to express them fast enough and completely enough. I decided that I needed to become a weaver. I had put off making that decision—there was so much to *know* about weaving. People earned advanced degrees in weaving. It would take so long to catch up, to gain the experience, skill, and knowledge that generations of development had given to weaving. It was exhausting, just thinking about it.

So I was overjoyed when I discovered the knitting machine. I could make tapestries with it. I could put designs in the fabric, and I could also design the fabric. I could make fabric and design meld and blend to convey a larger message. I could work in two dimensions or three dimensions. I could work large scale or small scale. I could still use my beloved yarns, and feel, build, and enjoy my fabric. It would be a fabric unlike any I had ever before produced. And best of all, I couldn't find anybody else who was doing it (I must have had my head in the sand!). That meant I didn't have to learn what generations before me had already learned, or so I thought. I could be a pioneer! What heady stuff!

As any pioneer will tell you, idealism provides wonderful motivation but is not too practical. It took more than three years, lots of determination, and plenty of tears, to get that first group of tapestries. I found that being alone in my technique meant that I had to figure out all the technical problems by myself, and that I had to convince museums, galleries, and jurors of shows of the legitimacy of a work of art knitted by machine, when knitting had always been thought of as something done "by hand." However, by the time of the Bicentennial, I had found a gallery and a person who believed that what I was doing was thoroughly legitimate—Julie Schafler-Dale of Julie: Artisans' Gallery in New York; a friend and colleague, Linda Mendelson, who was on a parallel path; and an audience in Julia Weissman. I was on my way.

I have since learned that knitting machines and machine knitted textiles have a rich and varied history of their own, dating back to the 16th century, which runs parallel to and often touches that of hand knitting. I have also learned that there are lots of people using knitting machines all around the world, that they use them for purposes other than tapestry-making, and that I am not alone with my machine at all!

So this book is the result of my experiences and research with machine knitted fabrics. Most of the information is pieced together from every source I can find. Some of it is my own invention, built upon what is already known. A lot of it is the invention of others, built upon what they already know, both in the historical and contemporary sense. All I have done, really, is to put it together in what I hope is a workable format. Julia encouraged me to write it down, and then she made it into a book. Ascertaining the market, negotiating with publishers, contacting other knitters, knitting machine importers, and the thousand other details that go into creating a book, are her work. She wrote parts of it, edited, arranged words and material, rearranged words and material, kept me from going off on too many tangents, and did most of the problem-solving and trouble-shooting. A formidable task.

Much of the material contained herein has been used, expanded upon, and generally tested, sometimes unwittingly and unknowingly, by my students. Giving them the raw materials—the technical information—and then watching them go through the thrill of discovery brings back my own initial thrill. So here it is for you, the raw material, to expand upon, put together in new ways, and use for unthought-of purposes.

Susanna E. Lewis
July, 1984 New York City

I might never have met Susanna Lewis nor, possibly, have heard of knitting machines had I not decided one day, a few years ago, to quit my desk job as an editorial assistant and become a freelance editor/writer and write a book about twentieth century American folk art. My editor suggested I go to Brooklyn to see some folk art owned by Susanna and Tim Lewis, which I did.

The folk art was intriguing, but equally interesting (in addition to Susanna's striking quilted and lace hangings and macrame lace curtains on the walls and windows of the Lewis's brownstone house) was an impressive apparatus consisting of a double row of latch hooks mounted on metal legs.

That, Susanna told me, was a Passap knitting machine. I was instantly curious, and she, at my request, demonstrated how it worked. She told me, too, that I could see some of the things she'd knitted on it at Julie: Artisan's Gallery on Madison Avenue. I went to Julie's the very next day, and, impressed with what I saw, asked Susanna if she'd work with me on an article about her and knitting machines. She said yes. Our article idea was rejected, so I suggested we try to do a book. To telescope history a bit, that idea we did manage to sell, and herewith, at long last, is that book.

My role, as it has turned out to be, was not so much that of writer as instigator and editor. I can't and never will match Susanna as a fiber artist and machine knitter, but I certainly can be as strong an advocate of machine knitting. Furthermore, not only has working with Susanna on this book been an extraordinary experience and pleasure, but it has been rewarding in other ways, because, as a consequence, I have met a whole galaxy of talented and interesting knitters and fiber artists, both here and abroad, and I consider my co-author, Susanna Lewis, to be its brightest star.

Julia Weissman
July, 1984 New York City

ACKNOWLEDGMENTS

As can be seen from the long lists below, this book is really the effort of more than two people. Every one of these people has contributed to it. Our main role has been to sift, compile, and organize the information. We are indebted to all the knitters, designers, fiber artists, teachers, authors, dealers, company executives, and friends, who so willingly shared their expertise, gave unstintingly of their time, listened to our agonies and ecstasies over this book, offered valuable advice and suggestions, and even let us use their machines. We are especially grateful to our students, who acted as editors for most of the concepts and methods in this book, and to our editor at Lark Books, Carol Parks, who has, with utmost expertise, patience, and perseverance, so beautifully assembled all the concepts, methods, swatches, charts, and diagrams into the book you now have before you.

We want especially to mention Helen Deckelman, vice president of Associated Knitting Machine Company from 1977 to 1983. She not only encouraged and supported us from the time this book was just an idea, but in addition to promoting the machines she represented, pushed hard for the recognition of all hand knitting machines as viable craft tools in this country.

Very special thanks to go Lewis Tager of Delaine Worsted Mills, in Gastonia, North Carolina, for providing the five shades of gray Acridel yarn needed to knit the swatches for the photographs, and to Chris Cook of Heirloom Yarns, Rochelle, Illinois, for providing the Century and Colony yarn needed to knit the jacket banner.

To Edith Stucki and Gabriele Schnetzer of Madag in Switzerland, manufacturers of Passap knitting machines, and to Raymond Galliath and Monique Uhl of Superba in France, manufacturers of Superba knitting machines, go our thanks for their long-time support, friendship, and technical assistance.

And to our fellow authors and teachers, without whose willingness to listen and share this book would not be possible, we thank you all: Gene Bailey, Regine Faust, Susan Guagliumi, Corky Haase, Pat Hampton, Kathleen Kinder, Jim Malkin, Linda Mendelson, Tami Nobuyuki, Jerry Olson, Hazel Ratcliffe, Jodie Raymond, Sadie Sheridan, Norma Sweet, Bonnie Triola.

To our friends who produce, promote, and organize classes, workshops, and seminars, where much of the material in this book has been taught and tested, our thanks for the opportunities you have granted us to teach, maintain contact with colleagues, gather new information and ideas and fresh approaches to old information and ideas, and lend us machines and accessories when we needed them: Trinka Reddie of Fibers, Marlow Heights, Maryland; Marlene Cuniberti of The Knitting Machine Studio, Englewood, New Jersey; Marjorie Campbell of The Knitting Machine Nook, Westbury, New York; Mary Ann Scherr of Parsons School of Design, New York, New York; Jack Russell of The Brookfield Craft Center, Brookfield, Connecticut; Karole Sales of School Products, Inc., New York, New York; Carolyn Dadisman of SeaDad Studios, New York, New York; Helen Deckelman, formerly of Associated Knitting Machine Co., Fairfield, New Jersey; Ed Schiffler of Leclerc Corp., Plattsburgh, New York.

And to others, whose contributions shall remain nameless but without whom this book would not have been possible, very special thanks to each of you: Tim Lewis, Alexa Lewis, Aury Lewis, Julie Schafler-Dale, Rick Barlow, Paul Wittenborn, Jane Hall, Ann Coleman, Mary Walker Phillips, Eve Rabinowe, Howie Mitchell, Penny Klemm, Linda Remo, Dolores Ferrard, Dolores Seifer, Jacquelyn Roesch-Sanchez, Susan Summa, Marika Contompasis, Janet Lipkin, Sharron Hedges, Nicki Edson, Norma Minkowitz, Arlene Stimmel, Amy Rothberg.

INTRODUCTION

This is a book about knitting fabrics, all the fabrics we could find that can be made on a hand knitting machine. We have made the book as comprehensive as we could, and have written it with all kinds of knitters in mind: from those who want to "hand knit" on their machines to those who want to design for production, and for the majority who want to do a little of both and much that is in between.

This book teaches the concepts and techniques of knitting various kinds of fabric *structures* on single and double bed machines. Only the structures themselves are discussed together with the mechanics of knitting them. Other aspects of knitting, such as patterning and yarns, are not dealt with except by example—and there are plenty of examples. This is not a stitch pattern book, nor is it a book of beautiful swatches knitted in fancy yarns. There are no projects here, and no discussion of garment design, garment drafting, or garment-making techniques. There are other books and periodicals and other instructors to teach you those subjects. And although one of the authors of this book is a fiber artist, there is no discussion of fiber art here, either. We want only to give you the facts about making fabrics, so you can use your own inventiveness and those wonderful yarns to knit beautiful stitch patterns in fabrics that enhance the garment designs you choose or the works of art you envision.

This book is for those who are familiar with the basic techniques of single and double bed machine knitting. If you understand most of the information in your machine's instruction manual, you are probably ready for the contents of this book. Although the techniques here are considered intermediate or advanced, and you may consider yourself a beginner, remember that you won't be a beginner for long, and the material here will give you ideas and something to look forward to when your skills have increased.

This book is meant to be an extension of your instruction manual, not a rewritten version of it or a replacement for it. We urge you to reread your manual and practice its instructions for a particular fabric or technique before attempting the same technique as presented here.

THE KNITTING MACHINES

There is a great variety of knitting machines available today. Their patterning capabilities range from simple, completely manual patterning to very sophisticated electronic systems. There are machines with very fine gauges, or needle spacing, for use with fine industrial yarns, and some with very large gauges (the bulkies) for use with the thick and fancy hand knitting yarns. Some machines are single bed, some double bed, and some convert from one to the other. All knitting machines will knit, tuck, slip, and hold stitches. And they all perform the same when it comes to plain knitting and simple patterning on single bed. All double bed machines will knit rib, tubular, and racked fabrics. Differences among the machines start to appear when you begin to knit specialty fabrics. Some machines can "weave," plate, or knit with two yarns at once. Others are able to change yarns or accomplish various stitch transfers quickly and efficiently. If there is a particular capability you want, you probably can find a knitting machine that has it. Every knitter we know is strongly tempted to acquire a whole room full of knitting machines. One purpose of this book is to show you that such a collection is unnecessary: almost every kind of fabric can be knitted, one way or another, on every machine. What one machine can do, others can be made to do. One machine may not knit a certain fabric as quickly and efficiently as another, but advancing technology will soon remedy that, either by developing a new model of a current machine or a new accessory to use with the present model. If you understand how a fabric is made, you can probably make it on your own machine regardless of your machine's age or its degree of sophistication. The information in this book applies to the older machines and those of the future too, for the fabrics will always be the same, even though the ease of knitting them and the patterning put into them will change as new equipment is developed.

These four machines were selected for demonstrating the techniques in this book because they are "middle of the road" hand knitting machines and are commonly used and widely known throughout the United States:

Passap Duomatic 80, with four-color changer and Deco punchcard selector.

Superba S-48 with electronic selection box for patterning.

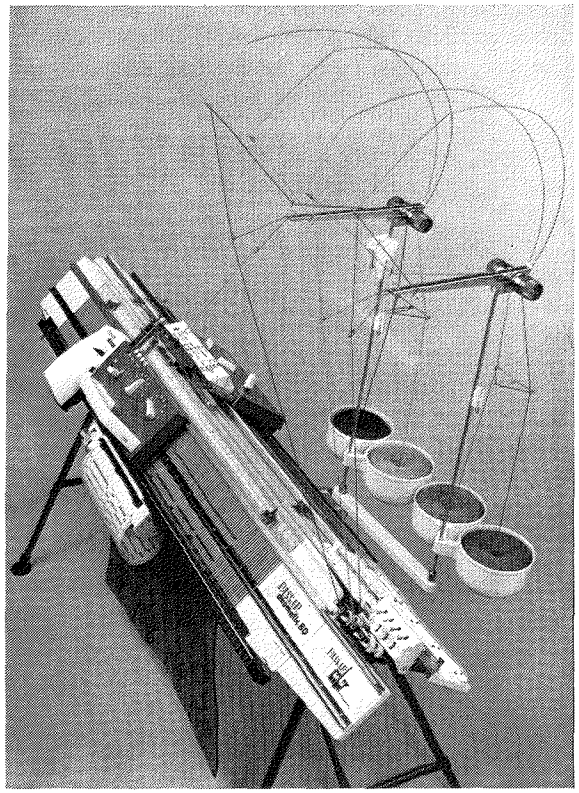
Brother KH 860 punchcard machine with KR 850 ribber and KRC 830 double bed four-color changer. The same machine (with the charting attachment) is also marketed as Knitking KH 881 with KR 900 ribber.

Singer, also known as Studio, SK 360 punchcard machine with SRP 50 ribber and YC 5 four-color changer.

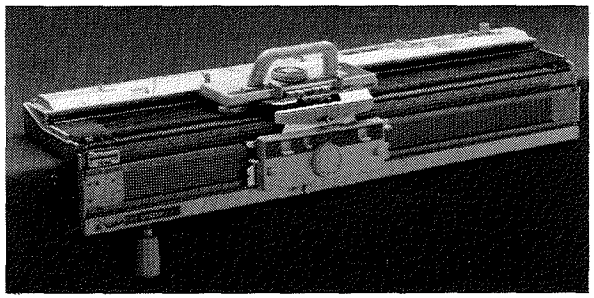
Throughout this book, we will often refer to the Passap and Superba models listed above as the "European machines" and the Brother/Knitking, and Singer/Studio models as the "Japanese machines."

The techniques in these chapters have been applied to all four machines. They should be applicable to your own machine, at least to some degree, even if you don't own one of these four. Cam settings and other technical information are cross-referenced so that knitters using one brand of machine can understand how another brand makes the same fabrics, and thus make use of another machine's material and patterns. Another purpose of this book is to teach knitters to think in generic terms instead of being tied to the terminology used by the manufacturer of one machine. A slipped stitch is a slipped stitch, and is the same on every knitting machine, whether it is called BX, slip, miss, empty, or part. If you can understand how to make a certain fabric manually on your machine, chances are good that you can incorporate your machine's automatic features to create the fabric more quickly. To help you along, some of the "recipes" in this book are written in generic terms. If you get stuck, the Reference chapters are there to help.

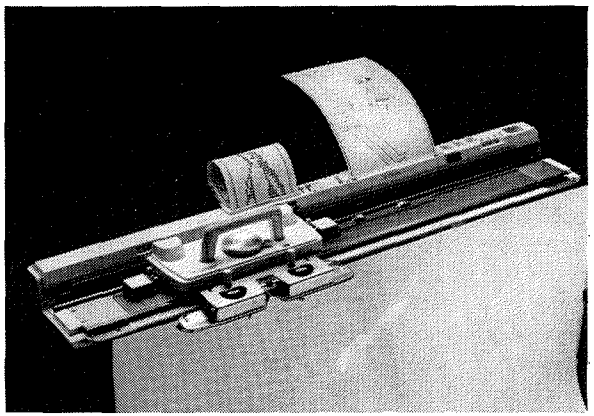
We would like to stress that not every fabric can be made as easily on one of these four machines as on another. Certain fabrics may be very impractical on a particular machine, and a few actually impossible. The information can still be useful. You may decide to shop for an upgraded machine, or a new accessory may appear on the market which simplifies an impractical technique. Or you may want to try an impractical technique on your machine just to understand how it is accomplished, and perhaps use it for a small area of a garment. The term "impractical" is relative. To a knitter who patterns manually on the machine, the technique may be just what he or she has been looking for, while to a production knitter the same technique would not even be considered.



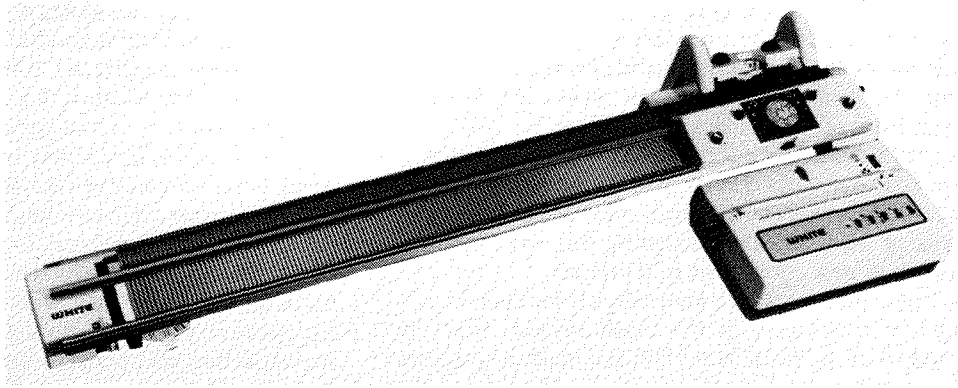
Passap Duomatic 80 machine, with four-color yarn changer and Deco.



Brother/Knitking, model KH 860 machine with KR 850 ribber.



Singer/Studio, model 360.



When this book went to press, Superba machines were not being sold in the United States under Superba's name. Shown here is the White model 1602, sold by the White Sewing Machine Company and made by Superba. It is marketed outside the United States as the Superba S-48, the machine used to knit the Superba fabrics described in this book.

USING THIS BOOK

Since this book is designed to be used as a reference as well as a teaching manual, we have tried to make each chapter as comprehensive and self-contained as possible. We do not imagine any knitter reading through it as if it were a novel. Instead we imagine the knitter picking it up to look up a small detail in a hurry, to work out one variation of a particular fabric, or to cross-reference one machine with another. To present the information so that it can be found quickly and easily was a major consideration in putting this book together.

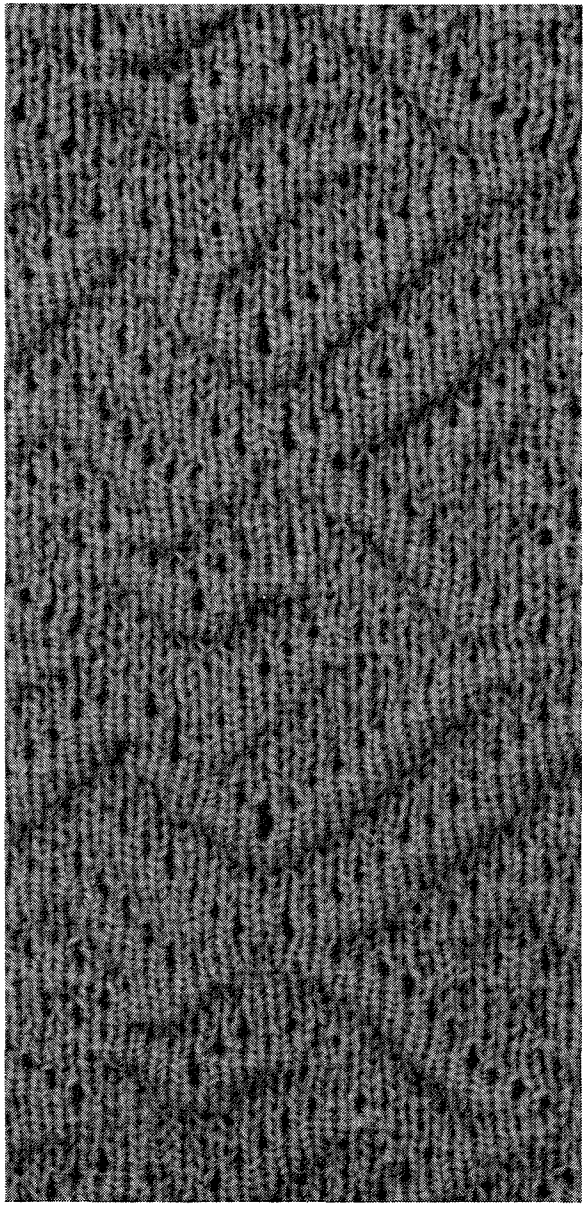
There is much information which applies to fabrics discussed in several different chapters, such as mechanical aspects of operating the knitting machine or its punchcard, or methods of punching designs on cards, or the use of a piece of accessory equipment. This kind of material can be found in Part One, the reference section. Here, too, are explanations for reading the charts, graphs, and diagrams found scattered throughout the book.

The glossary is also very important. Since there is no real standard, or generic, terminology among the various brands of hand knitting machines at the present time, we have tried to be very specific in defining the terms we use. When in doubt, look it up! A misunderstanding in meaning can be very costly in terms of time and temper.

Each chapter in Part Two is devoted to one major fabric construction technique and its variations. The fabric structures, together with the knitting process and mechanics involved, are explained in detail. Not all of the fabrics or variations mentioned in the text are illustrated. Some of the concepts and techniques from one chapter can be applied to the fabrics in another chapter. Since there wasn't space to show, or even discuss in detail, every example, we hope that as you go along you'll recognize the possibilities and try out your own ideas. After all, the blending of the boundaries between one fabric and another is the way new fabrics are invented. Pay attention to all your experiments, and be sure to write down your findings.

Have fun, and enjoy your knitting!

CHAPTER 1
How To Use the Material in This Book



There are several varieties of tables, charts, and diagrams used in this book. The gridded diagrams, needle set-ups, and tables are self explanatory. The stitch formation diagrams and cam charts are explained in this chapter as are the abbreviations and terms we use throughout the book. When in doubt, look it up!

ABBREVIATIONS

alt	alternate
BB	back bed
carr	carriage
CC	contrast color
CO	cast on
col	color
dec	decrease
DYG	double yarn guide unit (Superba)
EN	every needle
ER	every row
EON	every other needle
EOR	every other row
FB	front bed
FNR	full needle rib
HP	holding position
inc	increase
K carr	knit carriage (Brother/Knitking)
K	knit
L	left
L carr	lace carriage (Brother/Knitking)
MB	main bed
MC	main color
neg rev	negative reverser (Superba)
ndl	needle
ndl ret but	needle return button (Superba)
NWP	non-working position
P	purl
patt	pattern
patt pos	patterning position
prep	preparation row
pos	position
pos rev	positive reverser (Superba)
R	right
RC	row count (number of passes of carriage)
RP	resting position
SS	stitch size
st	stitch
var	variation
WP	working position
—	repeat the instruction between asterisks

GLOSSARY

Adjacent needles. Needles in WP next to each other and which knit in turn. In single bed work, they are adjacent on the same bed; in double bed knitting, they are across from each other on opposite beds.

All-over pattern. A repeated design or pattern extending across the length and width of the fabric.

Arrow keys. On both carriages of the Passap, these govern the automatic reversal of pushers in WP/RP. The L arrow key reverses the pushers when the carriages move left, the R key when they move right. Both keys together will reverse the pushers each row; the cancel key eliminates any reversal.

Automatic patterning. Pattern knitting predetermined by a punchcard, needle set-up, pusher positions, or cam settings. It does not involve manual manipulation of needles or cam changes.

Back bed (BB). On double bed machines, the needle bed farthest from the knitter, whether the main bed or second bed.

Background needles. See **Non-selected needles.**

Backing. The "wrong" side of a double bed fabric. It is usually that portion of the fabric knitted on the second bed or ribber.

Balanced and **unbalanced fabric.** In double bed work, if the number of knit rows between beds is the same, the fabric is balanced; if not, it is unbalanced. In single or double bed work, if the fabric structure at one part of the beds in relation to another part along the width is the same, it is balanced; if not, it is unbalanced.

Bias fabric. Selvedges are at an angle other than 90° to the cast-on and bound-off edges. The fabric stretches on the diagonal rather than vertically or horizontally.

Bind off. One of several methods for removing stitches from the needles and interlocking them to prevent unravelling of the finished edge. See **Cast off.**

Bird's-eye backing. One of two basic backings in rib jacquards. Alternate needles slip/knit every row to create the "bird's-eye" texture on the fabric face and reverse.

Blister jacquard. A double bed fabric in which either the design or background is separated from the backing and stands out in relief.

Bobbin knitting, bobbin weaving. See **Tapestry knitting, Tapestry weaving.**

Bobbles. See **Popcorns.**

Cables. Adjacent ribs two to five stitches wide which are crossed periodically to form raised, rope-like patterns.

Cams, cam settings. Metal or plastic tracks or pathways under the carriage through which butts of needles in WP travel as the carriage passes across the needle bed. Arrangement of the cams is governed by setting buttons or dials on top of the carriage to cause needles to move in and out of different positions for various kinds of knitting.

Carpet stitch. See **Pile knitting.**

Carriage (carr). A mechanism which moves back and forth on rails across the bed of the knitting machine. It houses the cams that engage the needle butts and determine their action. It has buttons, dials and levers to set cam positions and stitch size, and is equipped with a yarn feeder. On double bed machines, each bed has its own carriage; the two carriages are coupled during double bed knitting.

Cast off. An unfinished edge, i.e., stitches removed from the needles, usually at the end of knitting, without use of some method to prevent their unravelling. See **Bind off.**

Cast on (CO). The first one or two rows of knitting to place loops into the needles. There are several methods of casting on for both finished and unfinished edges.

Charting attachment. A device attached to the knitting machine to aid in shaping or patterning. A plastic or paper sheet on which the pattern is charted in graph or outline form is inserted into the attachment, which will rotate the sheet row by row as the knitting progresses.

Color changer (four color). An attachment that can hold four different ends of yarn and can exchange and feed them into the carriage during knitting.

Contrast color (CC). In two-color jacquard knitting it is usually the color which knits the design. When used with the double feeder, it is placed in the second feeder. See **Main color.**

Cross-bed transfer. Transfer of stitches from the needles of one bed to the needles of the opposite bed. This can be done manually with decker tools, or automatically with a cross-bed transfer carriage.

Cursor, cursor stops. On Superba, a small magnetic block attached to a belt on the back of the machine which in turn is connected to the scanner in the selection box. It travels with the main carriage to electronically transmit the pattern on the pattern card to the needles for selection in patterning. The cursor can be stopped at both left and right sides by the cursor stops, which can act as isolation cams if placed within the selvedges of the knitting.

Cut-and-sew. A shaping technique (for necklines, armholes, etc.) for fabrics too complex in stitch structure to shape on the machine. After the knitting is completed, the shape is outlined with sewing machine stitches and the fabric is cut along the outline.

Decker tools. Tools with eyeletted prongs used for transferring stitches. They are available with various numbers and arrangements of deckers.

Double bed. A knitting machine with two needle beds facing each other at about a 45° angle. Each bed has a carriage, and the two carriages are coupled to produce rib or double knit fabrics. Each bed may also be used as a single bed.

Double feed. Feeding two yarns, each from a separate feeder or feeding attachment, to the needles simultaneously. The position of the yarns is determined by the type of knitting and design of the machine being used. Double feed is used in jacquard, weaving, plating and intarsia.

Double jacquard. Another name for rib jacquard.

Double jersey. Another name for eight-lock.

Double knit. See **Rib fabric.**

Double rib. Another name for interlock rib.

Drop stitch fabric: A fabric with openings created by dropping selected stitches and allowing them to unravel.

Eight-lock. Double bed reversible fabric made by the interlock technique but in a wider needle selection. It can be a jacquard pattern, and when done in two colors, the pattern is also reversible.

Embossed fabric. Double bed relief fabric consisting of a single knit background with double knit rib, pile, or jacquard pattern. The background is in purl stitch while the pattern is often in Long Stitch to create a sharp contrast in texture.

European machines. For the sake of brevity, we use this term throughout the book when referring to the Passap Duomatic 80 and Superba S-48.

Eyelets: Small openings created by various techniques, generally for decorative purposes.

Face side. The side of the fabric facing the design or main bed during knitting. In stockinette, it would be the knit side.

Fairisle. Colored jacquard designs of small repeats traditional to Fair Isle knitting. The term is often used to include all colored jacquard designs knitted single or double bed.

Fisherman's rib and **half fisherman's rib.** A standard knit fabric also known as *cardigan* and *half cardigan,* and by other names. It is made on double bed by alternating rows of knit with rows of tuck. In full fisherman's rib, both beds alternate knit/tuck; in half fisherman's rib, only one bed will alternate knit/tuck while the other knits plain.

Float or **weft.** A strand of yarn which occurs on the reverse or purl side of a single bed fabric and crosses over one or more needles without being hooked onto a needle or knitted into the fabric.

Free move. Setting the cams on one or both carriages so they can be moved across needles in any position without disturbing them.

Front bed (FB). On a double bed machine, the needle bed closest to the knitter, whether the main bed or second bed.

Full needle rib (FNR). (1) A basic needle set-up for many double bed fabrics; all needles in the knitting area are placed in WP and the beds at half pitch. (2) The fabric resulting from the set-up as in (1). When knitted plain on both beds, it is a very elastic ribbed fabric. Unless otherwise stated, "FNR" in patterning directions means to set the carriages on both beds to knit.

Full pitch. On double bed machines, the two beds are set so their needles are exactly opposite. On Japanese machines, the pitch lever is set to P; on Passap, the racking handle is up; on Superba the intermediary lever is to the left.

Garter bar. A comb with eyeletted prongs which fit over needle hooks for easy removal and replacement of a row or group of stitches when knitting garter stitch, transfer patterns, cables, etc. Used with Japanese machines.

Garter stitch. A reversible pattern made by knitting and purling alternate rows. It is characterized by horizontal ridges on both sides of the fabric. On double bed machines it can be made by transferring stitches back and forth between beds on alternating rows; on single beds, by taking all stitches onto a garter bar, turning the knitting over and rehanging the stitches every row.

Gate posts. See **Sinker posts.**

Gauge. Stitch and **row.** The number of stitches and number of rows in a given unit of measurement, used as a basis for calculating stitches and rows necessary to knit a shape to a given size.

Grafting. A method of hand-joining the unfinished loops or edges of two pieces of knitting by using a needle and matching yarn to create an extra row of stitches between the two pieces, which makes an "invisible" join.

Graph or **chart.** A pattern drawn on plain or grid paper or plastic sheet. It can be run through the charting attachment to serve as a guide for knitting a garment shape or fabric pattern. It can also be a stitch-by-stitch guide for making a punchcard or knitting a complex pattern.

Grin-through. In a double knit fabric, the extent to which the stitches of one side of the fabric show through the other side.

Half Milano backing. A common method of knitting double bed jacquards or embossed fabrics. The main bed knits one row for every two rows knitted on the second bed, thus the backing has twice the number of rows as the face and causes the design stitches to stretch lengthwise. Also known as **Long Stitch.**

Half pitch. On double bed machines, the two beds are set so that the needles of one bed are exactly opposite the sinker posts of the other. On Japanese machines, the pitch lever is set to H; on Passap the racking handle is down; on Superba, the intermediary lever is to the right.

Holding position (HP). When needles are in holding position they will hold previously knitted stitches yet remain out of action while further knitting is occurring on other needles. This position is also an alternate method of making tuck stitches on all machines except Passap. See **Pull-up.**

Inlay. A technique in which an extra yarn is laid in among the knit stitches but is not knitted itself.

Intarsia. A fabric, usually jersey or stockinette, incorporating geometric shapes of at least two colors and knitted in such a way that each yarn knits its own shape without moving behind the fabric to another area, hence no floats are created.

Interlock rib. A basic double bed fabric knitted in FNR set-up. Both beds have an alternating 1x1 needle selection, knitted with a knit/slip cam setting. The fabric is very stable and semi-elastic, with a smooth texture on both faces. Interlock rib is often used on one bed only, as a backing (bird's-eye) or combined with stockinette (knit-weave).

Intermittent feed punchcard rotation. On Japanese machines and Superba, a punchcard row can be changed with every second pass of the carriage; i.e., the punchcard rotates every other row. Passap punchcards can rotate in this manner, and can also be set to rotate every four rows. See **Regular feed.**

Isolation cams. Small plastic cams, used when knitting with a punchcard, to interrupt the pattern across the bed where desired. They are used principally to isolate a motif in jersey or rib jacquard. On Passap, they are called *positioning pins;* on Brother/Knitking, *one point cams;* on Singer/Studio, *point cams.* On Superba, the cursor stops can function as isolation cams.

Jac 40. A hand-held punchcard reader. A punchcard is inserted into a slot and small "teeth" protrude through the punched holes. When the reader is positioned on the needle bed, these teeth select needles for patterning.

Jacquard, Joseph Marie. A French inventor who, in 1805, combined the work of other inventors to create a punchcard patterning device for weaving looms which automatically selected warp threads to be raised or lowered for pattern weaving. This made possible the rapid weaving of complex patterns.

Jacquard knitting. Design or "picture" knitting with two to four colors in each pattern row. The design is usually first charted in color on graph paper, then transferred to a punchcard; or it may be knitted by manually selecting the needles for each color in the design.

Jacquard punchcards. Cards punched especially for knitting from two to four colors into each pattern row. Some jacquard cards can also be used to knit one-color textured patterns.

Jersey. See **Stockinette.**

Japanese machines. We use this term throughout the book when referring to the Brother, Knitking, Singer, Studio, and other Japanese-made machines comparable to these.

Jersey jacquard fabric. A single bed fabric in stockinette, characterized by a knitted design of two to four, or more, colors per row. The reverse of the fabric is covered by floats.

Knit-in. Another name for jersey jacquard.

Knit/purl fabric. An embossed fabric in which the knit stitches of the pattern are made on one bed and the purl stitches on the other, to produce a jersey fabric with both knit and purl stitches on both faces.

Knit side. The face or smooth side of a stockinette fabric.

Knit stitch. (1) A completely formed stitch and the basic stitch of knitting. When the needle rises or extends to its fullest length, the previously formed stitch falls behind the latch. New yarn is then taken into the hook, and as the needle returns or descends, the old stitch forces the latch to close over the hook containing the new yarn. The old stitch passes off the needle, and the new yarn has formed a new stitch. (2) The smooth or face side of the stitch.

Knit-weave. A double bed fabric composed of alternating rows of either full needle rib or interlock rib, and stockinette.

Lace fabric. A fabric characterized by a predominance of open spaces. It can be knitted in a variety of techniques on both single and double bed.

Ladder. A vertical space in the knitting characterized by short horizontal floats which are created by dropping a stitch and allowing it to unravel, or by leaving a needle in non-working position. Several adjacent stitches can be laddered to create fringes or other decorative open spaces.

Latch up. To manually knit or "latch" the floats of a ladder with a crochet hook or latch tool. The stitches can be latched in knit or purl stitch, or with another yarn.

Lateral transfer. The transfer of stitches from needles of one bed to other needles on the same bed, using decker tools or a lateral transfer carriage.

"lili" buttons. Our acronym (pronounced "lily") for a pair of buttons, on the front bed carriage of Brother/Knitking and Superba, which will automatically select every other needle to patterning position in either or both directions. The selection always begins with the second needle the carriage encounters. There is also a lili setting on the Superba garter carriage (A) and the Passap U-80 (#2).

Lock. The German word for carriage, used by Passap.

Long Stitch. Another name for Half Milano, usually used in describing an embossed pattern.

Main bed (MB). The bed containing the punchcard pattern reader and device for automatic selection of needles for a pattern. On single bed machines, this is the only bed. See **Second bed.**

Main color (MC). In two-color jacquard knitting it is usually the color that knits the background stitches. When used with the double feeder, it is placed in the main feeder. See **Contrast color.**

Manual patterning. Pattern knitting involving at least some manual selection of needles, usually with the aid of a pattern ruler, Jac 40, or stitch transfer tools.

Mesh fabric. A fabric composed of evenly spaced holes or eyelets, framed by a minimum of knit stitches. It is the basis of all lace fabrics and can be made by a number of techniques.

Mock garter stitch. A non-reversible pattern that imitates the appearance of garter stitch on one face only. On double bed machines it can be made by two techniques: drop stitch and cross bed transfer. See Embossing chapter.

Mosaic knitting. A type of color knitting in which two (or sometimes more) colors alternate every two rows. Some stitches are slipped or tucked each pattern row in such a way that the design resembles a maze.

Motif. A design or pattern knitted into one or more selected areas of a fabric.

Needle. That element of the knitting machine which actually produces the stitch. The needles are lined up in slots parallel to one another across the width of the needle bed. Each needle can make one vertical column of stitches. The needle is composed of four parts: The *hook* holds the knit loop. The *latch* closes over the hook, allowing the previously knitted loop to slide off and a new loop to be formed. The *stem* is the length of the needle between the latch and the butt. The *butt* is a raised, rounded projection on the stem near the bottom end. It moves through the cam track in the carriage, which causes the needle to be raised and lowered.

Needle bed. A flat, rectangular assemblage of metal and plastic parts, approximately 45 inches long and 6 inches wide, with parallel slots or grooves along its length. Each slot holds one needle. The long edges are equipped with rails along which the carriage can move back and forth over the needles.

Needle rule. A standard format for setting up selvedge needles in double bed knitting. In FNR set-up, the first needle on the front bed is at the left, and the first needle on the back bed is at the right.

Needle selection. In pattern knitting, selected needles are moved into patterning position, either manually or by punched holes on a punchcard, to receive yarn from the feeder and make a plain knit stitch. Needles not selected remain in working position and act according to the cam setting. On some machines, needles can be selected for stitch transfer in the same manner.

Needle set-up. The arrangement of needles in working and non-working position at the start of knitting, after casting on.

Non-selected needles or background needles. In contrast to pattern or selected needles, these do not move out to patterning position and knit; instead they remain in WP and act according to the cam setting on the carriage. They correspond to the unpunched spaces on a punchcard.

Non-working position (NWP). (1) On all machines, needle butts are against lower rail of needle bed. Needles in this position remain out of action entirely. (2) On Passap, pushers within the blocking rail. Pushers in this position remain out of action entirely.

Nopps. Raised bumps or bobbles made by tucking for at least two rows (usually four to eight) on two needles separated by at least one needle knitting plain. The condensing of the fabric where the two needles are tucking causes the plain stitch(es) between to stand out in relief. Nopps can be made on single or double bed.

Partial knitting. Another name for short rows.

Pattern needles. See **Selected needles.**

Patterning position. The position of needle butts on the machine bed during pattern knitting. These needles will knit regardless of the cam setting.

Pattern repeat. The repetition of a design or pattern across the width and length of the fabric governed by the length and width of a pattern punched on a card or selected manually. Also, the repetition of a needle set-up coupled with the number of rows knit at various cam settings.

Pattern row. In jacquard punchcards, one pattern row is the number of punched rows on the card needed to complete one sequence of knitting. It is the same as one horizontal row on the original graphed design.

Pattern ruler. A hand-held plastic or metal strip with teeth on one or both long edges, used for manual selection of needles or pushers for patterning. Pattern rulers are available with various teeth combinations, some adjustable.

Pile knitting. A double bed relief fabric characterized by short loops held in place by the backing.

Pin tucks. Horizontal rolls or tubes in relief on the surface of the fabric. They are usually knitted double bed, but can also be knitted single bed by picking up stitches from several rows below and hanging them on needles to form the roll.

Plain knitting. All needles in working position knit with no slipping or tucking. May be done single or double bed.

Plating. A technique whereby two yarns are knit simultaneously in such a way that one yarn shows on the face of the fabric and the other on the reverse.

Popcorns or **Bobbles.** Isolated bumps or raised groups of stitches made by a variety of techniques. They are used decoratively in an embossed pattern.

Preparation row. In punchcard knitting, the pattern of a punched row on the card is set in the needle (or pusher) selector prior to the actual knitting of the row by making one pass of the needle selector past the card reader. (The needle selector is located in the carriage on Brother/Knitking and Singer/Studio and in the Deco on Passap.) This first pass to set the memory is called the preparation row. On Superba a preparation row is not needed.

Pull-up. On Japanese machines and Superba, another way of making a tuck stitch. The needles to form tucks are put in HP and a loop of yarn crosses over the needle stems with each pass of the carriage. It is particularly useful in combining tuck and slip stitches in the same row with knit stitches.

Punchcard reader. An attached or built-in device to hold the punchcard. When activated, it advances the card row by row, and, by means of plastic "feelers" that protrude through the punched holes, it reads the punched and unpunched spaces on each row of the card. A needle selector, built into or attached to the carriage, then passes across the feelers and selects needles to correspond with the arrangement of the feelers for each punched row.

Punch lace. Lace made by knitting in two colors, one of which is a transparent nylon thread which gives the illusion of spaces.

Purl loop. The horizontal loop on the reverse side of a knit stitch. When filling in empty needles during knitting, it is this loop that is picked up and hung on the adjacent empty needle. See **Sinker loop.**

Purl side. The reverse side of a stockinette fabric.

Purl stitch. The reverse side of a knit stitch.

Pushers. On Passap, these are metal jacks placed in channels underneath the needles on both beds. They are used for needle selection in patterning, for holding stitches, and for special kinds of knitting, such as half tubular. They can be manually placed in WP, NWP, or RP. On the front bed only, they can also be arranged automatically in WP and RP by a punchcard and the Deco. Punched holes on the card will cause corresponding pushers to move to working position. The arrow keys on both carriages can be used to automatically reverse the WP/RP arrangement of pushers.

Ravel cord. When a piece of knitting is begun with waste yarn, and before the main knitting is started, one row is knitted first with a ravel cord of smooth cotton or nylon. When knitting is completed, the waste yarn is separated from the main knitting simply by pulling out the ravel cord. It can also be used to hold stitches temporarily during knitting.

Regular feed punchcard rotation. On Japanese machines and Superba, a punchcard row can be changed with each pass of the carriage, i.e., the card rotates every row. Passap punchcards cannot rotate every row. See **Intermittent feed.**

Release stitch. Another name for drop stitch.

Relief fabric. A single or double bed fabric with portions of the fabric knitted so as to be raised from the rest of the fabric and create a three-dimensional texture.

Resting position (RP). On Passap, pushers are outside the blocking rail and placed against its top edge. Their respective needles act according to the cam setting on the carriage.

Reverse side of fabric. The side facing away from the main bed during knitting. In stockinette, the purl side. On double bed machines, the reverse is the side facing the second bed or ribber.

Reverser. On Superba, the second switch from the right on the selection box, which determines needle selection for patterning. The positive reverser (upper position) selects needles corresponding to blackened areas on the punchcard; the negative reverser (lower position) selects the non-blackened areas on the card.

Reversible fabrics. Double bed fabrics with the pattern showing on both sides, either in the same, or reversed, color sequence. The stitch texture also may be the same or reversed.

Ribber. See **Second bed.**

Rib, rib fabric. (1) So-called double knit fabric, made double bed, usually in FNR set-up, wherein knit stitches show on both sides of the fabric. (2) Double bed fabric characterized by vertical stripes of knit and purl stitches.

Rib jacquard fabric. A double bed fabric with a jacquard design on the fabric face, knitted in two to four colors per pattern row, with a backing which also contains all the colors. It can vary widely in structure and texture.

Ripple fabric. A double bed relief fabric characterized by a design or surface of pin tucks or nopps.

Row count (RC). In pattern directions, this term is often used to indicate the number of passes of the carriage in the repeating sequence: i.e. "RC2" instead of "knit 2 rows." This term is used because the carriage must sometimes make more than one pass to complete 1 row of knitting.

Row counter. A device attached to the machine to count passes of the carriage across the needle bed. A trip-cam on the carriage advances the numbers as it goes by the counter.

Second bed. On double bed machines, this bed is opposite the main bed (which contains the automatic patterning mechanism). Automatic patterning possi-

bilities on the second bed are less sophisticated, and in a double bed fabric it is generally used to knit the backing. On Japanese machines, this bed is called the ribber. See **Main bed.**

Selected needles or **Pattern needles.** Those needles selected manually or by punched holes on a punchcard to move into patterning position, receive the yarn from the carriage, and knit plain.

Selvedge. The side or vertical edges of the fabric as opposed to the cast-on or bound-off edges.

Set-up. The arrangement of needles in WP and NWP at the start of knitting, usually after casting on is completed.

Shadow lace. Another name for cross-bed transfer lace.

Shadowed reverse. Usually a double bed fabric wherein the design on the face of the fabric shows on the reverse, but in a different, less defined stitch structure. Often seen in rib jacquard fabrics. Needle selection for the pattern is required on the MB only.

Short rows. A technique for shaping fabric, and knitting intarsia, by knitting across only a portion of the needles holding stitches while non-knitting needles are placed in holding position. This will create more rows across one segment of the fabric than another, or will allow colored areas to be knitted separately.

Single bed. A knitting machine with one needle bed plus a carriage. It can produce jersey or stockinette fabrics of various types.

Single feed. A method of feeding one yarn at a time to the needles, in contrast to double feed, which feeds two yarns simultaneously.

Skip stitch. Another name for mosaic knitting.

Sinker loop. As the needles make knit stitches, the yarn passes from one needle to the next either in front of or around the sinkers. This element of the knit stitch is called the sinker loop. Sinker loops and purl loops together make very pronounced horizontal ridges on the reverse, or purl side, of the fabric. See **Purl loop.**

Sinkers or sinker posts. Along the top edge of the needle bed and in between the slots containing the needles are either small vertical metal posts or protrusions in the area between the slots. These are the sinkers (or sinker posts or gate posts). When the needles form loops, the yarn must travel around the sinkers from one needle to the next; this aids in the stitch formation and prevents stitches from becoming too tight on the needles.

Slip stitch. A missed stitch. A needle containing a stitch made on a previous row but which does not rise to knit a new stitch. The yarn will travel by it and make a float instead. Slip stitch is used in patterning where more than one color is used in a row, to make textured patterns of floats, and as one way of holding stitches for short rows.

Stitch size (SS). The relative size of a knit stitch in a given yarn, determined by the distance the needle descends to pull a new loop of yarn into its hook. This distance is adjustable and is governed by a calibrated dial on top of the carriage. See **Gauge.**

Stockinette or **jersey.** A single bed fabric knitted with needles in WP. The face shows a smooth texture of knit loops, while the reverse shows horizontal ridges created by the sinker and purl loops.

Striper backing. One of the two basic methods of knitting a backing in rib jacquards. All the needles on the second bed knit every row, creating horizontal stripes two rows high.

Tapestry or **bobbin knitting.** A manual method of knitting complex color patterns or intarsia in stockinette. Separate strands of yarn knit, each in their own color areas, across the fabric width.

Tapestry or **bobbin weaving.** Similar in concept to tapestry knitting. Separate ends of yarn for color changes are laid in manually where needed across the row, then the carriage with the main yarn is passed across to lay them into the knitted stitches. See **Inlay.**

Tension arm. An assemblage of spring wires and tension control discs mounted on the back of the machine. It carries the yarn from cone or ball to the feeder on the carriage, maintaining sufficient tension to produce even, loop-free knitting. Each arm holds one yarn. Tension can be adjusted according to the yarn used and type of knitting done.

Transfer, single and multiple. Transferring one stitch (single transfer) or several adjacent stitches (multiple transfer) to other needles, either laterally or cross-bed.

Transfer pattern. Any knitted pattern involving transfer or shifting of stitches from one needle to another, either laterally or cross-bed. May be done manually, or automatically with appropriate accessories.

Transfer tools, pronged or eyelet. See **Decker tools.**

Tubular knitting. Stockinette knitted on two beds in such a way that the yarn knits on alternate beds, always from the same direction, in a circular fashion. The resulting fabric will be a tube.

Tuck loop or **tuck stitch.** An incompletely formed stitch. The needle rises high enough for the hook to take new yarn, but not so high that the previous stitch falls behind the latch. When the needle descends, the previous stitch is still in the hook, together with a new loop of yarn. The loop is the tuck stitch, or, technically, the tuck loop. Several tuck loops can be collected in the same hook, over several rows. The combining of tuck stitches with knit stitches is one of the principal ways of making stitch patterns on the knitting machine.

Waste yarn. Yarn used either at the start or finish of knitting, or both, usually to produce an unfinished edge. This yarn will be removed later to leave an edge to be finished by hand or joined to the edge of another piece of knitting.

Weaving. An inlay technique for single bed knitting.

Weft, weft knit. In double bed knitting, a strand or float of yarn crossing over one or more needles on one or both beds without being hooked onto the needles or knitted into the fabric. It is usually enclosed within the rib stitches.

Working position (WP). (1) On all machines, the position of the needle butts on the machine bed that readies the needles for knitting. (2) On Passap, the pushers are placed halfway up their channels; their respective needles will then knit regardless of the cam setting.

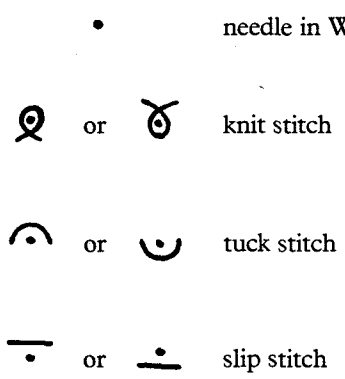
Wrapping needles. A method of preventing eyelets and creating a solid join in short row and intarsia knitting. The first needle in holding position adjacent to the last needle which knitted is "wrapped" by placing the yarn in the hook or around the stem. If an eyelet is desired, the needle is not wrapped.

Yarn changer. See **Color changer.**

HOW TO READ THE STITCH FORMATION DIAGRAMS

These diagrams are placed as adjuncts to the text, cam charts and swatches to help you visualize and better understand the knitting of complex double bed fabric structures. Their purpose is to show as clearly as possible how one sequence of a particular fabric is knitted.

SYMBOLS USED IN STITCH FORMATION DIAGRAMS



Arrows indicate carriage direction; numbers indicate the knitting order of the rows in the sequence.

Pitch is indicated beside each diagram.

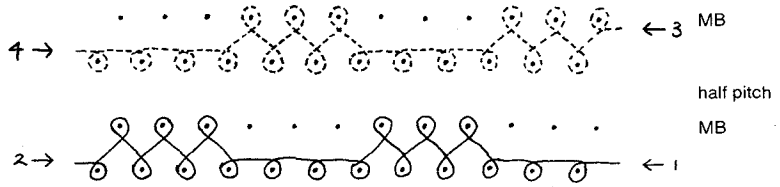
When two colors are represented, the solid line indicates color 1; the broken line indicates color 2.

Most of the diagrams are for double bed fabrics, hence there are two horizontal rows of dots per diagram to represent the needles of the two beds. The lines represent the yarn moving back and forth between the needles.

The main bed is always shown as the back bed and the second bed as the front bed, with carriages beginning each sequence from the right side. Every machine differs with respect to the MB and carriage starting side, but it shouldn't be difficult to reverse the two beds or the direction of the carriage to fit any particular machine.

The examples of jacquard patterning (on the MB) are shown in the diagrams as vertical stripes three needles wide; that is, the fabric *would* be striped if the sequence shown were knitted several times in succession. The diagrams are wide enough to show four stripes. If in two colors, they will be alternating stripes of dark and light; in one-color textured patterns, they will be stripes of knit stitches alternating with stripes of tuck or slip stitches.

Most fabrics require more than one diagram to show a complete sequence. They are always read from bottom to top, the way you actually knit. You must mentally superimpose them to visualize the complete structure.



Sample stitch formation diagram (for striper backing, described in the Jacquard chapter).

HOW TO READ THE CAM CHARTS

The left column lists the specific fabrics for which instructions are given in the adjacent text and photo captions. There is then a column for each machine. At the top, next to the machine name, is the usual starting position of the carriage for each pattern, determined by the placement of the color changer. Exceptions are noted in the individual boxes.

If a box is blank, or missing, the fabric cannot be made, or is too impractical to knit on that machine. Within each box the punchcard type is indicated in the upper right corner. For Superba and Japanese machines, card rotation also is noted here. Any special accessory needed is listed in the bottom left corner of the box.

Cam notations are written as follows: whatever is above the horizontal line refers to the back bed; whatever is below the line, the front bed. Any button, lever or setting not indicated should be in normal or neutral position according to the instruction book.

On the Japanese machines especially, some fabrics can be knitted by more than one method, or by switching directions of knit and tuck, for example. Don't be afraid to experiment!

Following are specific notations for the different machines.

	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Striper Backing **1 row pattern = 2 rows backing** **or** **2 rows pattern = 4 rows backing**	Type A N / BX← Deco 4 RC2 ea col	Type A - Norwegian jacquard Type C1 - EOR o / Λ RC2 ea col claw	Type B - ER Type C1 - EOR Type C2 - ER part ↔ / N N RC2 ea col	Type B - ER Type C1 - EOR Type C2 - ER △ slip △ / 1 1 RC2 ea col

Sample cam chart (striper backing is described in the Jacquard chapter).

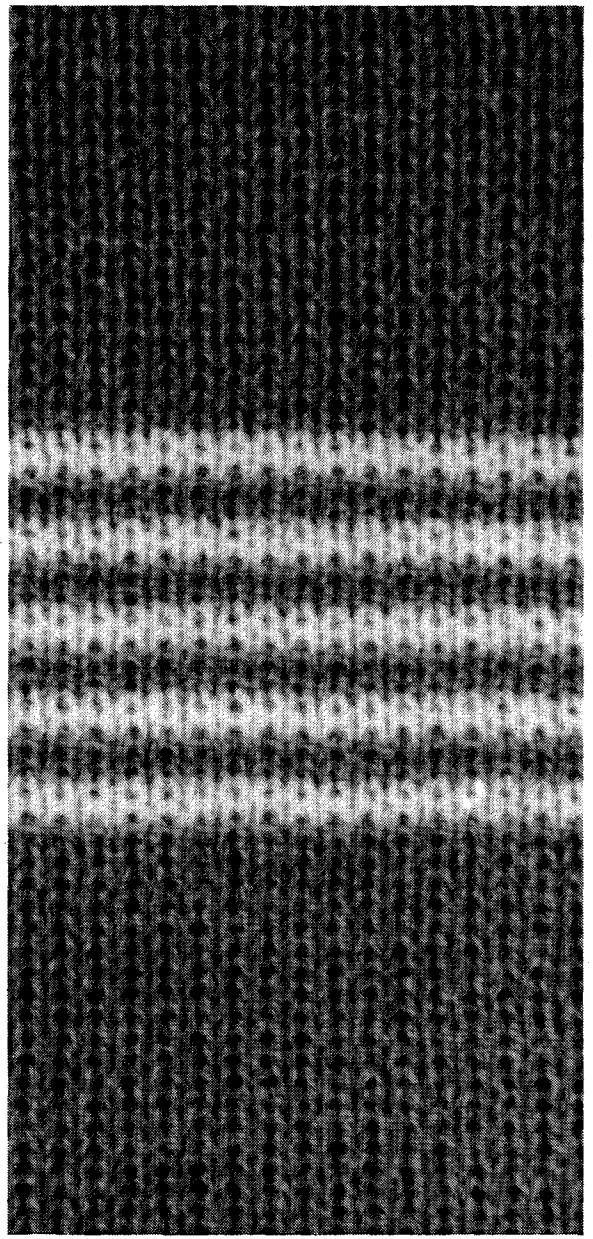
Passap. If pushers on FB are in identical set-up on both beds, the notation will read WP/RP for both front and back beds. If they are set up opposite on each bed, it will read WP/RP for one of the beds, and RP/WP for the other. Assume that whenever the Deco is used, pushers on FB are either all in WP or all in RP, it doesn't matter which.

Superba. Arrows to indicate the position of the needle return buttons are the same for both beds. If they point upward, this means upper position; if they point downward, it means lower position. "No right cursor stop, cursor at right" means to lock the right stop at the end of the bed so it won't function, and place the cursor at the right side of the carriage where it remains throughout the pattern. The left cursor stop will be in position as usual. In all patterns, note carefully on which side the carriage begins. It is usually from the right, unless the Jac claw is used for two colors, when it usually starts from the left.

Brother/Knitking. Here a kind of shorthand is used to indicate cam settings, because the usual way of writing them takes too much space. The arrows for the main bed carriage indicate which direction(s) the carriage should tuck or slip. On the ribber carriage, the slip/tuck center button should always be in the slip position unless tuck is specified on the cam chart.

Singer/Studio. On the main bed, side levers back are indicated by a triangle, side levers forward by a circle. On the ribber carriage, the pick knob should always be in the slip position unless tuck is specified on the cam chart.

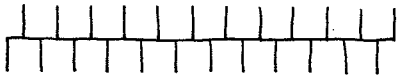
CHAPTER 2
The Basics



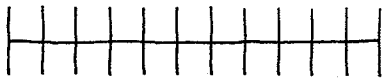
This section contains the general information pertaining to the needle beds and cam settings. Also included are instructions for the fabrics we consider to be so elementary that the directions for making them should be permanently etched into one's memory. Here, too, is the material for cross-referencing the carriage settings for your machine with those of another.

BED POSITIONS FOR DOUBLE BED KNITTING

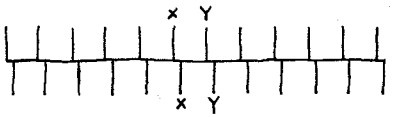
Before the needles are set up for double bed knitting, beds must be placed in one of three positions, which will determine the relationship of the front and back bed needles to each other. Of the bed positions shown in the next section, the two most common are "half pitch," where the needles alternate with each other; and "full pitch," where the needles are opposite each other. To maneuver the beds into one position or the other, there is a pitch lever adjacent to the racking handle on all machines except Passap, which uses the racking handle itself. A third position, "quarter pitch," is used by Passap and Superba when a cross-bed transfer carriage is employed for stitch transfer. Quarter pitch is midway between full and half pitch. Superba has a special lever for putting the beds in this position; on Passap the racking handle is turned to the 9 o'clock position.



Half pitch position. Needles between beds alternate with each other.



Full pitch position. Needles between beds are opposite each other.

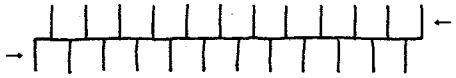


Quarter pitch position, the transfer position for Passap and Superba. Needles of the back bed are slightly to the left of corresponding needles on the front bed and will transfer to each other in either direction (pairs marked x *and* y. *If the front bed is racked one needle right to the next quarter pitch position, the front needle,* x, *and back needle,* y, *will transfer to each other.*

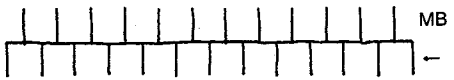
NEEDLE RULES FOR DOUBLE BED KNITTING

The term *needle rule* refers to the arrangement of the selvedge needles in double bed set-ups. The needle rule for the most common double bed set-up, full needle rib (FNR), is shown in most instruction manuals as the set-up below, with the first needle on the front bed at the left, and the first needle on the back bed at the right. This configuration follows in the most common rib set-ups as well.

In many fabrics, however, the needle rule acts only as a point of departure for configuring the selvedge needles in another way, in order to make neat selvedges in the fabric. A phrase commonly encountered in this book goes something like this: "Add an extra needle on the second bed to break the needle rule," resulting in the set-ups shown below.

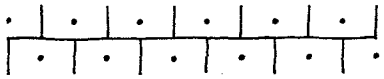


Normal set-up in full needle rib

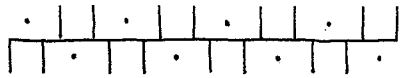


Extra needle on the second bed

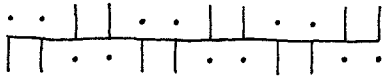
The needle rule also applies to other common rib set-ups, such as these.



Set-up for 1x1 rib, beds full pitch.



Set-up for 2x1 rib or 2x2 industrial rib, beds half pitch. Rack 1 needle left or right when casting on.



Set-up for 2x2 rib, beds full pitch. Rack 1½ needles when casting on.

	Passap	Superba	Brother/Knitking	Singer/Studio
Non-working position (NWP): no sts on ndls	ndls RP	o	A	A
Working position (WP): sts in hooks of ndls	ndls WP	1	B	B
Patterning position (patt pos) & bringing individual ndls from HP to WP: sts either on the latches or just behind the latches. Passap: sts in hooks	ndls WP and pushers WP	2	D	C
Holding position (HP): sts on stems of ndls. Passap: sts in hooks.	slip stitch cam settings only ndls WP and pushers RP or NWP	3	E	D

NEEDLE POSITIONS ON THE NEEDLE BEDS

Non-working position (NWP). Needles are pushed all the way down against the rail so that their butts are not fed into the carriage.

Working position (WP). Needles are pushed up to where the tops of the hooks are in even alignment with the sinker posts; butts will be fed into the lower cam track of the carriage. This is the normal position for plain, or stockinette, knitting, with the appropriate cam setting.

Patterning position (patt pos). For knit/slip or knit/tuck patterning on Superba and the Japanese machines, selected needles are pushed up either manually, or automatically by a punchcard, to where the spoons of the latches are in even alignment with the sinker posts. They will be fed into the upper cam track of the carriage and will always knit, no matter what the cam setting may be. The needles remaining in WP will be fed into the lower cam track and will slip or tuck according to the cam setting.

For knit/slip or knit/tuck patterning on Passap, pushers in WP cause corresponding needles always to knit, no matter what the cam setting may be. Pushers in RP or NWP (within the rail) cause corresponding needles to act according to the cam setting. Pusher selection may be either manual or by the Deco.

Holding position (HP). This position is for holding a group of stitches while another group is being knitted, for short rowing, and for tuck patterns on Superba and the Japanese machines (where it is used principally for combining knit/slip/tuck in the same pattern row).

On Superba and Japanese machines, needles are pushed up as far as possible so the butts are not fed into the upper cam track of the carriage. There are special buttons or levers on the carriage that act upon these needles, either to bring selected ones into HP (Superba only) or to knit them back into WP, all at the same time. To bring individual needles out of HP into WP, push the needle back to patt pos; the carriage will pick it up, knit it, and return it to WP.

For Passap, HP is possible only on slip stitch cam settings. In stockinette, pushers are placed in WP for the stitches to knit, RP for stitches to be held. Cams are set to BX for stockinette, or HX for tubular stockinette. If the pushers in WP and RP are already being used for patterning, as in jacquard knitting, then the stitches to be held must have their pushers in NWP. To hold stitches in a tuck pattern, the *needles* must be in NWP. When knitting a single bed tuck pattern, you can remove stitches from the needles with waste yarn or stitch holders, or transfer them to the opposite bed. With double bed patterns, knit the needles down to NWP with a ravel cord or waste yarn, holding the needle butts in place with masking tape.

CAM SETTINGS FOR BASIC KNITTING OPERATIONS

The chart illustrating the basic cam settings is largely self-explanatory. If you want to translate directions for another machine to your own, check which of its symbols for a certain action corresponds to the ones on your machine for the same action. The following describes what the various symbols represent:

The Singer/Studio ribber carriage and both Brother/Knitking carriages have separate cam keys for setting slip, tuck or knit in various combinations, either to left or right. The Singer/Studio MB carriage has one cam setting coupled with side levers for the action of the carriage in each direction with no pattern card in the reader. If the side levers are forward, on the circle symbol, the needles will act according to the cam setting. If they are back, on the triangle symbol, the needles will knit regardless of the cam setting. With a punchcard in the reader and the side levers on the circle symbol, all the needles will act according to the cam setting; if levers are on the triangle symbol, the card pattern will be knitted.

Superba has only one cam key for the action of the carriage in both directions. But it also has a tubular key, and on this setting the carriage always knits in the direction the arrow points, and it slips (or tucks, if the tuck key is also used) in the opposite direction. This helps you keep track of which bed knits first in a given direction.

Passap also has one cam setting for the action of the carriage in both directions, but it has several such settings for various combinations of knit/slip and knit/tuck.

For those of you who like the Passap pattern books, but use another kind of machine, the synopsis of each cam setting below will help translate Passap's directions to your machine. Keep in mind that on Passap both carriages have the same cam settings, both beds have pushers for selective patterning, and both have left and right arrow keys to reverse the pusher setting. Either one or both keys can be used; they will reverse the pusher setting in the direction the arrow points while the carriage is moving across the bed.

	Passap	Superba	Brother/Knitking	Singer/Studio
Knit	N / N	△ / △	plain / N N	stockinette / 1 1
Slip	GX ; BX with pushers / GX BX	o / o	part/part / part/part	o slip o / o ← o
Tuck	AX with pushers / AX	⌒ / ⌒	tuck/tuck / part/tuck/part	o tuck o / o ∩ o
Tubular	CX; HX & DX with pushers / CX HX DX	C / Ↄ	part ← / N part	o slip △ / 1 ← o
Fisherman's Rib	EX ; FX with pushers / EX FX	C⌒ / Ↄ⌒	tuck ← / N tuck part	o tuck △ / 1 ∩ o
Jersey Jacquard with double feed	GX / BX ← pushers WP/RP single feed only	↑⊓∧↑ / o use double yarn guide	MC	knit-in
To keep ndls in HP while knitting on other ndls	pushers RP or NWP	needle return buttons center pos	HCL button H / HCL levers H H	Russel Levers I I / I I
To knit back all ndls in HP	*pushers WP*	*needle return buttons lower pos*	HCL button N / HCL levers N N	Russel Levers II II / II II

Note 1: All notations above horizontal line refer to back bed.
All notations below horizontal line refer to front bed.

Note 2: Back bed is main bed (MB) on Superba, Brother/Knitking, Singer/Studio.
Front bed is main bed (MB) on Passap.

PASSAP CAM SETTINGS

AX Tuck in both directions. Pushers in NWP or RP will allow their needles to tuck, those in WP will cause their needles to knit.

BX Slip both directions. Pushers in NWP or RP will allow their needles to slip, those in WP will cause their needles to knit.

CX Tubular stockinette. No pushers necessary. Front bed knits right to left, back bed knits left to right.

DX Tubular tuck. Pushers in NWP or RP will allow their needles to tuck, those in WP will cause their needles to knit. Front bed knits/tucks right to left, back bed knits/tucks left to right.

EX Fisherman's rib both directions. No pushers necessary. Front bed knits right to left, tucks left to right. Back bed does the opposite.

FX Fisherman's rib both directions. Pushers in NWP or RP allow their needles to knit fisherman's rib as with EX setting. Pushers in WP cause their needles to knit plain in both directions.

GX Slip both directions. Pushers and needles in WP will *not* knit. This setting is for free move.

HX Tubular slip. Pushers in NWP or RP will allow their needles to slip, those in WP will cause their needles to knit.

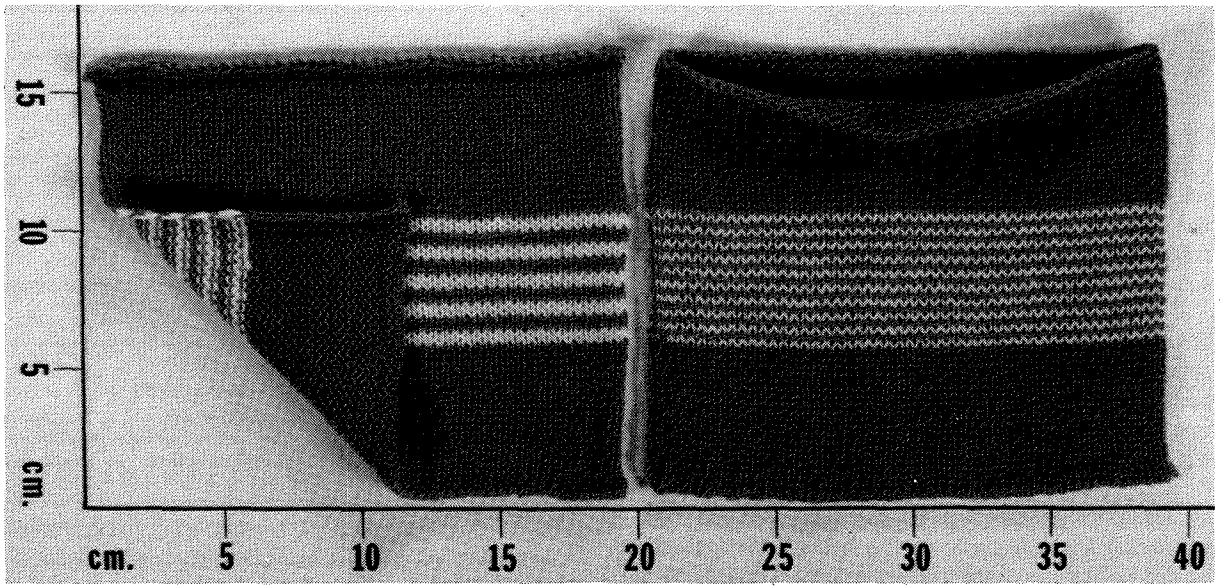
N Knits all needles in WP regardless of pushers.

THE BASIC FABRICS AND THEIR STITCH SIZES

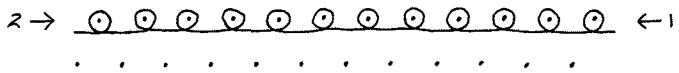
There are certain very basic fabric structures which can be knitted on any double bed knitting machine. It is important for every knitter to have a good understanding of how these fabrics are made on a particular machine, how the fabric is structured, and the qualities of the finished fabric. It also is important to understand technical factors such as the cam setting, relative stitch size, suitable yarn, adjustment of weight, and so on. It is upon these fabrics that a majority of the fabrics in this book are based. The ability to knit a good swatch of these basic ones is essential for success in knitting their variations and in designing and knitting more complex fabrics. Below is a brief synopsis of the six basic fabrics. Included for each is the approximate stitch size relative to the stockinette stitch size used for a given yarn, and a stitch formation diagram. The illustrated swatch of each fabric was knitted in FNR set-up. Each was knitted with the same yarn and the same number of stitches and rows, so you can see their relative proportions. The center stripes in the swatches were knitted RC2 each color in every case, to better illustrate the structure. In all cases, the direction of the carriages and setting of the cams can be reversed from those shown, if desired.

Stockinette, jersey, or **plain knitting.** Knit on one bed. All needles knit every row. The two sides of the fabric are not alike. During knitting, the knit side faces the needles, the purl side faces the opposite bed.

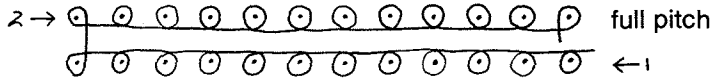
Tubular stockinette, or **circular knitting.** Knit on two beds, which alternate with each pass of the carriage. Each bed knits with the carriage passing from the same direction throughout, and the yarn travels in a circle. The fabric is stockinette, and since it is in a tube, both sides are alike. This swatch was knitted with the total row count doubled in order to achieve the same number of rows as the plain stockinette swatch. Stitch size on both beds is the same as for stockinette.



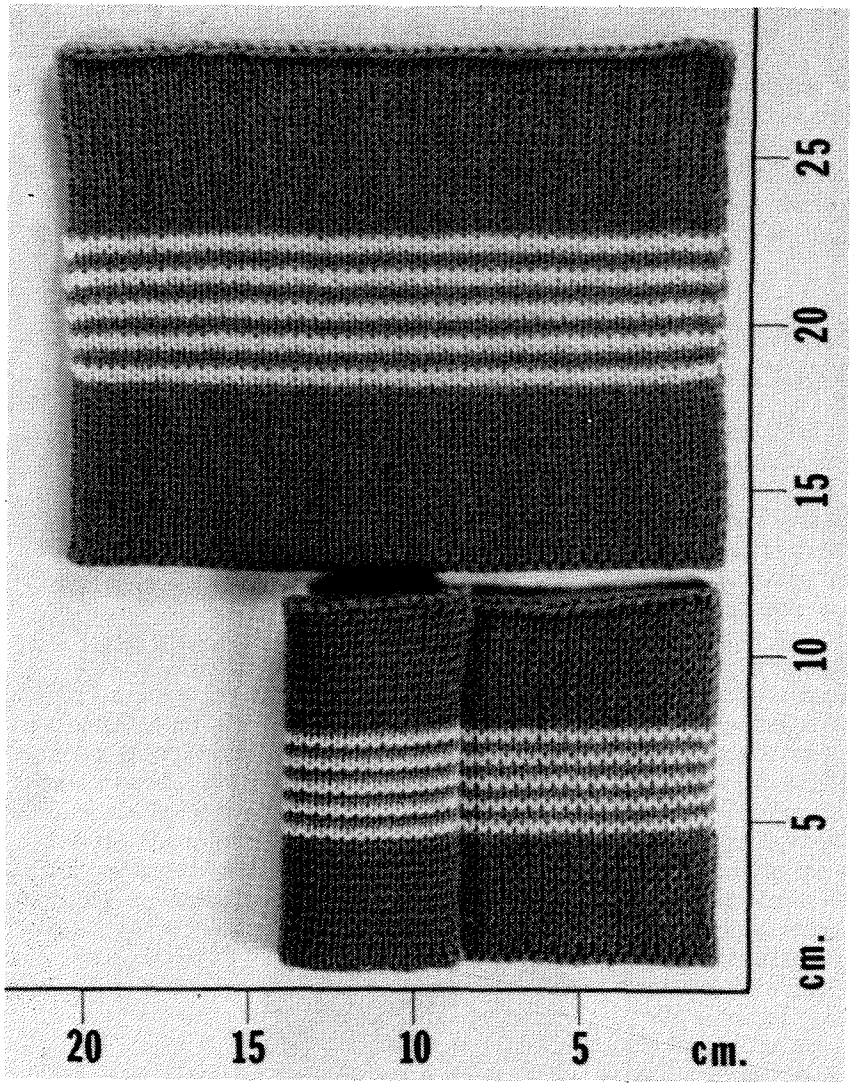
Left. Stockinette, jersey, or plain knitting.
Right. Tubular stockinette, or circular knitting.



Stockinette.

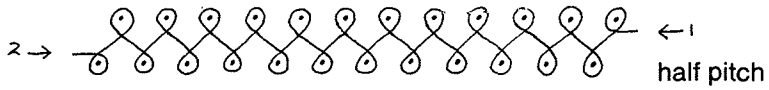


Tubular stockinette.



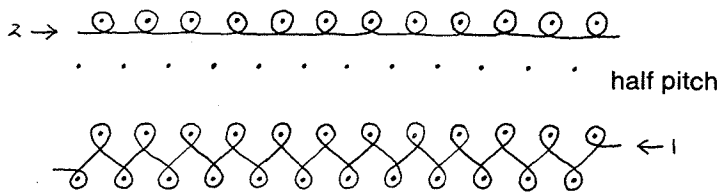
Top. Full needle rib, knit/knit, close rib, plain rib, or double rib.
Bottom. Long stitch, or half Milano.

Full needle rib, knit/knit, close rib, plain rib, or **double rib.** Knit on two beds, with all needles knitting in consecutive order every row. The two sides of the fabric are alike. The stitch and row gauges should be fairly close to those for stockinette. Stitch size on both beds is approximately 2 to 2.5 numbers smaller than for stockinette.

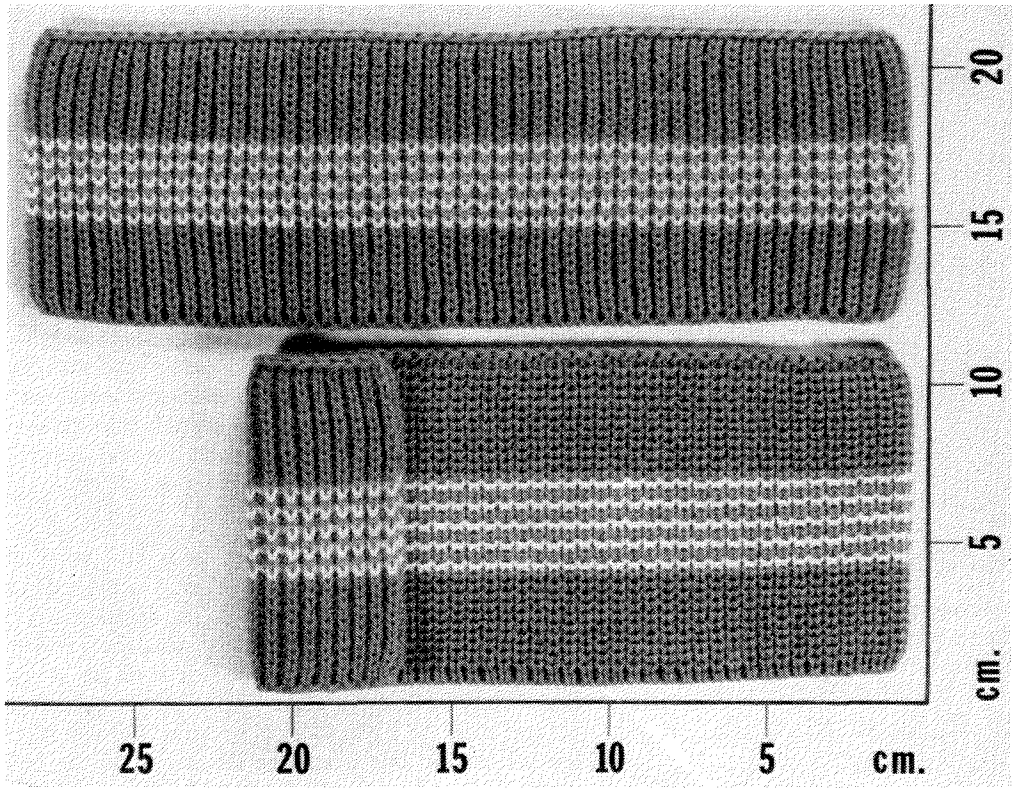


Full needle rib.

Long stitch, half Milano. Knit on two beds, with two rows of knitting required to complete one sequence. On the first row, both beds knit with all needles knitting in consecutive order. On the second row, one of the beds knits alone (in the diagram this is the back bed). In the finished fabric, since there will be twice the number of rows on one side as on the other, the two sides will not be alike. This swatch is somewhat shorter than the FNR swatch, because alternate rows are missing on one side. The stitch size on the bed which knits all rows (the back bed here) should be about 2 to 2.5 numbers smaller than for stockinette; for the bed which knits alternate rows only, about 1 to 1.5 numbers smaller than that of stockinette.



Long stitch.

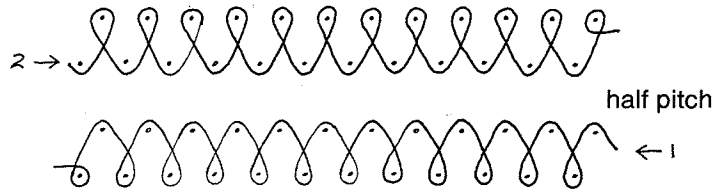


Top. Full fisherman's rib, or cardigan stitch.
Bottom. Half fisherman's rib, half cardigan, or English rib.

REMEMBER THESE POINTS WHEN CHOOSING STITCH SIZE

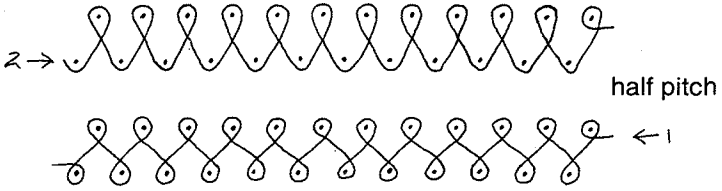
When knitting in tuck stitch on one or both beds, use a stitch size that is smaller than for stockinette or FNR. When knitting in slip stitch on one or both beds, choose a stitch size that is larger than that for stockinette or FNR. The choice will depend somewhat on the proportion of needles knitting and slipping or knitting and tucking. When knitting double bed, the stitch size can be different on the two beds.

Full fisherman's rib, cardigan stitch. Knit on two beds. On one bed, the back bed here, all needles tuck from right to left and knit from left to right. The front bed does the same, but in reverse. The two sides of the fabric are alike. Since a tuck loop is not a formed stitch and therefore does not add any length to the knitting, the fabric shortens about half, as compared to the same number of RCs in FNR. Note how the tuck loops push the ribs apart, making the fabric wider. The stitch size on both beds is about 3 numbers smaller than that of stockinette.



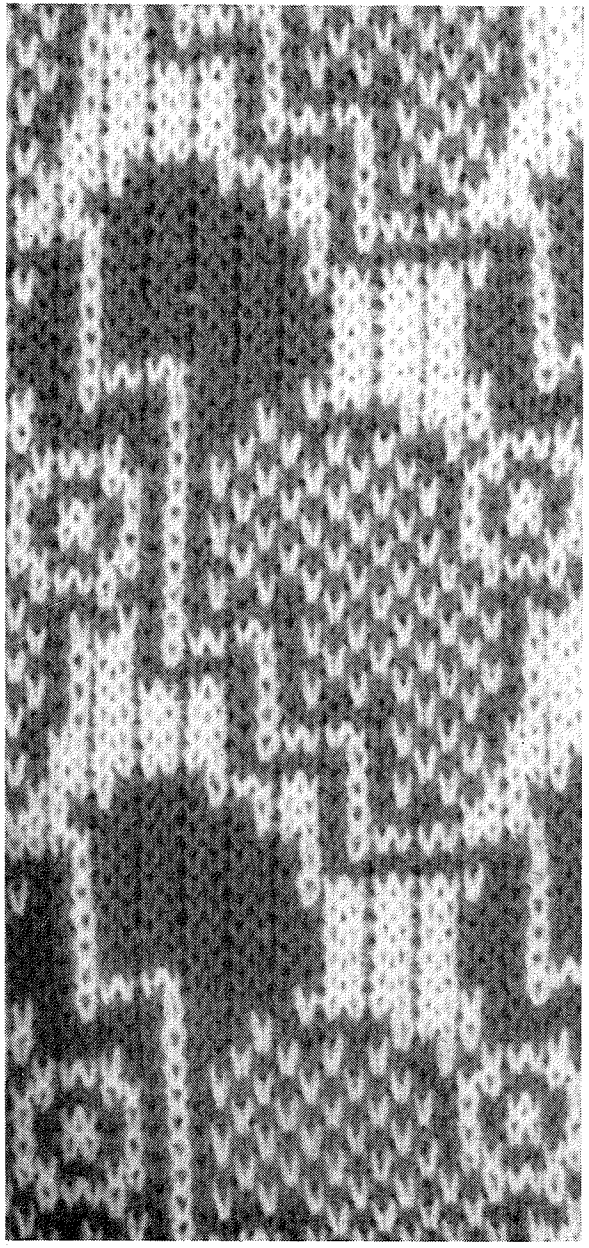
Full fisherman's rib.

Half fisherman's rib, half cardigan, or **English rib.** Knitted on two beds. One bed, the back bed here, knits in both directions while the opposite bed knits and tucks as in full fisherman's rib. The two sides of the fabric are not alike. The side which knits in fisherman's rib looks like the fisherman's rib swatch, while the side which knits all rows has short, fat knit stitches, called *pearls* or *purls*. Because one bed is not forming tuck loops but is knitting all stitches, the fabric is slightly longer than the full fisherman's rib. The stitch size on both beds is about 2.5 to 3 numbers smaller than that of stockinette.



Half fisherman's rib.

CHAPTER 3
The Mechanics of Punchcard Knitting



In this chapter we discuss the capabilities and limitations of the automatic patterning system, which must be considered when planning a design. And, as an aid to owners of other electronic machines, the switches for the settings on Superba's electronic selection box are outlined.

AUTOMATIC PATTERNING MECHANISMS

On Passap, Brother/Knitking, and Singer/Studio, automatic needle selection is done by a punchcard inserted into a reader and "memorized." This is accomplished by a mechanical needle selector in the carriage on Singer/Studio, in the needle bed on Brother/Knitking, and in the Deco on Passap. All the selectors operate in nearly the same fashion. The selector must pass over the card reader in order to memorize the selection of each horizontal row on the card, at least one row prior to knitting it. This is known as the *preparation row.* During knitting, the card is automatically rotated to the next horizontal row, and while the carriage is knitting the current selection, the selector is memorizing the selection on the next row.

On Superba, needle selection is done electronically by a scanner in the selection box which "reads" the blackened and non-blackened areas on each row, and transmits this information, by means of the cursor, to the needle selector in the carriage. This occurs as the row is being knitted; no preparation row is needed.

The automatic patterning mechanisms work with only one of the two beds on each machine. This is called the main bed (MB) and is the back bed on Superba, Brother/Knitking, and Singer/Studio. On Passap it is the front bed.

Brother/Knitking and Superba do have limited automatic patterning on the second bed. The two *lili* buttons on the carriage will automatically select EON with each pass of the carriage. Selection always begins with the second needle the carriage encounters; therefore, to knit alternating groups of needles each row, an even number of needles must be in WP.

Passap has very versatile automatic selection on the second bed. The pushers can be used to select needles in a continuous selection in any arrangement the knitter chooses. In addition, the arrow keys will reverse the selection automatically.

PUNCHCARD SELECTION

On Superba, Brother/Knitking and Singer/Studio, needle selection from the punchcard is made directly on the needles. On Superba and Singer/Studio, actual selection for the current row is made as the carriage passes over the needles; on Brother/Knitking it is made at the end of the previous row so that the selection for the next row is visible and can be changed manually, if desired, before the row is knitted. On Passap, selection is made indirectly on the needles by means of the pushers. As the carriage with the Deco passes over the pushers, the Deco selects the pushers which in turn select the needles. The Deco can be uncoupled and passed over the pushers by itself to make the selection for the next row visible, as on Brother/Knitking, the selection can then be changed manually, if desired, before the row is knitted.

MANUAL SELECTION WITHOUT A PUNCHCARD

On Superba, Singer/Studio, and Brother/Knitking, needles on both beds can be selected manually by moving them into patterning position on the needle bed by hand, or with a pattern ruler or a Jac 40. The needles must be selected again every row because the cams in the carriage return all needles to WP as the row is knitted. The exception is in pull-up or tuck patterns where needles are placed in HP and will remain there for as many rows as desired. The pushers on Passap can also be selected manually by the same methods. On Passap, pushers will stay selected in the same configuration every row until manually changed. Inasmuch as there are pushers on both beds, and arrow keys on the carriages to reverse them, manual patterning on both sides of a double bed fabric is very versatile and easy to do.

PUNCHCARD PATTERN WIDTH AND POSITION ON THE NEEDLE BED

On Passap, the maximum repeat width of a design is 40 stitches. Since the card reader can be moved along its rail to any desired position, there is no fixed position for the repeat on the needle bed.

For Superba there are two types of pattern cards, geometric and decorative. The geometric card is gridded like the punchcards for other machines, and has a maximum repeat width of 60 stitches. The decorative card is blank; a freehand drawing or other design is applied with opaque ink or black pressure-sensitive film, or shapes cut from opaque paper and taped in position. The maximum repeat is 180 stitches—the full width of the needle bed. As with Brother/Knitking and Singer/Studio electronic machines, the positioning of the repeat on the bed can be anywhere the knitter chooses, and there are virtually unlimited possibilities for pattern variation by means of the settings on the selection box.

On Brother/Knitking and Singer/Studio, the pattern on the 24-stitch punchcard will be knitted on the center section of the needle bed—12 needles on either size of zero—and on consecutive 24-needle sections to each end of the bed. The position of the repeat is fixed and cannot be moved.

To sum up, on Brother/Knitking and Singer/Studio, both the position and the width of the repeat are fixed. On Passap and Superba geometric cards, the position is flexible but the width is fixed. Consequently on Brother/Knitking and Singer/Studio, the knitting must be placed on the bed in such a way that the repeat falls in the desired place on the knitting. On Passap and Superba, the knitting can be placed anywhere because the reader/scanner can be moved where needed. Because all the machines have a fixed width for their punchcards, all the patterns for cards in this book are given in both a 24-stitch repeat width, for Japanese machines, and in a 20-stitch repeat width, for European machines.

HORIZONTAL ONE—WAY DESIGNS ON PUNCHCARDS

On Passap, Brother/Knitking and Singer/Studio, the needle selecting mechanism (for automatic selection from a punchcard) selects needles on the bed in the same orientation as the punched holes on a given row on the card. For example, the left side of the repeat on the card will appear on the left side of the repeat in the knitting *as viewed on the machine.* This means that a horizontal one-way design, such as letters of the alphabet, must be punched in reverse in order to appear correct in the finished knitting. The easiest way to accomplish this is to draw the design on graph paper as you want it to appear in the finished product, turn the punchcard over, then mark and punch it from the back side exactly as you charted it. Be sure not to turn it upside down when you do this.

On Superba, the scanner in the selection box reads the horizontal row in the *opposite* direction that the carriage will move, which means that the right side of the repeat on the card will be on the left side of the knitting *as viewed on the machine.* So, letter forms and other one-way designs are put on the card in the *same* orientation as they are to appear in the finished knitting. This is also important when positioning the design in the knitting. For example, if a design is to appear in the knitting from needles 1 through 60 at the right side of zero, then square number 60 on the card must knit needle number 1 at the right of zero on the needle bed, and the scanner must be set accordingly.

MAKING A MIRROR IMAGE OF A DESIGN

None of the machines used in this book is capable of automatically making a mirror image of a design on a vertical axis. If the design with its mirror image is too wide to fit on the card, then you must make another piece of knitting with the card turned backward (but not upside down) and join the two pieces after knitting. On Passap, Brother/Knitking, and Singer/Studio this can be done easily.

On Superba, the geometric program card cannot be turned backward, nor can a decorative card if the design has been drawn on paper. Our solution, for both kinds of cards, is to blacken the images on a piece of fine gauge clear or matte acetate film (available in tablet form in art supply stores). On decorative cards, the acetate can be taped in place inside the program card cover in whatever orientation you choose, as the blackened image appears on both the front and back of the acetate. Even small pieces of designs can be assembled and taped individually. For geometric cards, the acetate must be taped in position over a blank geometric card, with the squares on the acetate lined up exactly with the grid. Trim the top and sides of the acetate first so the edges do not interfere with the positioning studs at the top or the reference line at the right. The acetate can then be turned backward and retaped, and/or rotated 90° if you like, for a mirror image. The same solution works for shapes cut from opaque paper, in which case the acetate film can be eliminated.

For all machines, mirroring on a horizontal axis is easier. On Passap, Brother/Knitking, and Singer/Studio, punch one vertical repeat of the design on the card. To mirror it, remove the card after the first rotation is complete, turn the card backward *and* upside down and knit the next rotation. On Superba you can mirror this way automatically by configuring the reference line on a geometric card to rotate backward at the end of the first repeat, or on a decorative card by pulsing switch number 5 in the opposite direction at the end of the first repeat.

STOPPING THE PUNCHCARD

Certain fabrics, such as ripple and blister, require stopping the punchcard so that more than two rows can be knitted with the same needle selection. This is how to do it.

On Passap, after knitting the first row of selected needles, the carriage will be at left. Uncouple the Deco, set at 2 or 4, so it remains at the left end of the bed. Knit the required number of rows. Just before the last row is knitted, and while the carriage is at left, reconnect the Deco and continue. Sometimes it is more convenient not to connect the Deco to the carriage at all. Instead, set it at 2, and move it separately, left to right to left, to change the selection as needed. The carriage will then knit alone, with the Deco uncoupled.

On Superba, set switch number 4 in the lower position *before* beginning to knit the pattern row. When you have finished the desired number of rows with that selection, reset switch 4 to the center position, and the card will rotate according to the setting on switch 2. If the next pattern row is also

stopped, you can instead pulse switch 5 once in the appropriate direction.

On Brother/Knitking and Singer/Studio, stop the card after the row selection has occurred but just before the row is knitted. Knit the number of rows needed. Just prior to knitting the last of these rows, set the card to go; the next selection will be memorized as the last row is being knitted.

PREPARATION ROW

On the Passap Deco, the direction of the preparation row for all punchcard types is the same, from left to right. The Deco is set to rotate the card every two or four rows, depending on the type of knitting. It isn't possible to rotate the card every row on the Passap. On Japanese machines, the preparation row may be from either direction if the card is to rotate every row. It depends on the type of knitting and whether the color changer is to be used. If the card is set to rotate every other row, the preparation row is always right to left, with the first knitted row of patterning from left to right. Superba machines do not require a preparation row, and as with the Japanese machines, the card can rotate either every row or every other row.

CARD NOTATIONS

You may wish to place notations, such as color numbers and arrows indicating carriage direction, in the card margins. These should be made on the card after it is punched. Keep in mind that these notations must be moved upward a certain number of rows, depending on the punchcard starting row for each machine. For Singer/Studio, the first punched row notation is placed at the sixth punched row. For Brother/Knitking and Superba, it is at the eighth row, and for Passap, the seventh.

BLANK CARDS

The standard blank card sizes are as follows (not including rows for overlap). Passap: 40 stitches by 48 rows. Superba: 60 stitches by 78 rows. Brother/Knitking and Singer/Studio: 24 stitches by 60 rows.

SUPERBA'S ELECTRONIC SELECTION BOX SETTINGS

This summary of Superba's box settings is intended to give owners of other electronic machines some understanding of how the pattern cards on this machine can be manipulated or modified. We are referring to the five switches at the bottom of the selection box, which affect both types of pattern cards as well as automatic 1x1 patterning without a card. Remember that the patterning appears on the main bed only, and the cams on the carriage must be set to slip, tuck, tubular, or jacquard in order to make the patterning appear in the knitting.

Switch 1. Off/on.

Switch 2, upper position. Positive reverser. Blackened spaces on the pattern cards will cause corresponding needles to be selected and to knit. Needles corresponding to non-blackened spaces will act according to the cam setting. The principle is the same as that of punched and unpunched holes on punchcard machines. On the jacquard cam setting, blackened spaces cause selected needles to knit the yarn in the second yarn guide; non-selected needles will knit the yarn in the main feeder.

Switch 2, lower position. Negative reverser. Needles corresponding to non-blackened spaces on the pattern cards will be selected to knit. Needles corresponding to the blackened areas will act according to the cam setting. The needle selection for jacquard is also reversed.

Switch 3, upper position. "Norwegian jacquard" setting. Automatic switching from positive to negative reverser occurs every two passes of the carriage. The position of switch 2 determines whether positive or negative is first. If positive is first, the sequence for each pass of the carriage is as follows: pos, neg; neg, pos; pos, neg; neg, pos; and so on. If a pattern card is used, it will advance automatically every two passes of the carriage (EOR), so the black areas of a row can be selected on one pass, and the non-blackened areas of the same row can be selected on the next pass, before the card rotates. For the next pattern row, the non-blackened areas would be selected first, then the blackened areas. This action is useful for knitting single feed jacquards using a Type A card but knitting with a Type B selection, and for certain kinds of intarsia knitting with a Type A card.

Switch 3, middle position. The pattern card advances every row (ER rotation).

Switch 3, lower position. The pattern card advances every other row (EOR rotation).

Switch 4, upper position. Automatic 1x1 needle selection occurs with or without a pattern card. The selection reverses ER or EOR, depending on the position of switch 3. If a pattern card is used with this setting, the 1x1 selection occurs in the non-blackened spaces only, no matter which reverser is used. This is useful for filling in background areas with a check or textured pattern in most any type of patterning. Without a pattern card, and coupled with switches 2 and 3, various 1x1 stripe patterns can be knitted automatically.

Switch 4, middle position. The pattern card advances ER or EOR automatically, depending on the position of switch 3.

Switch 4, lower position. The pattern card stops rotating and provides the same needle selection continuously.

Switch 5. Directional advance for card rotation.

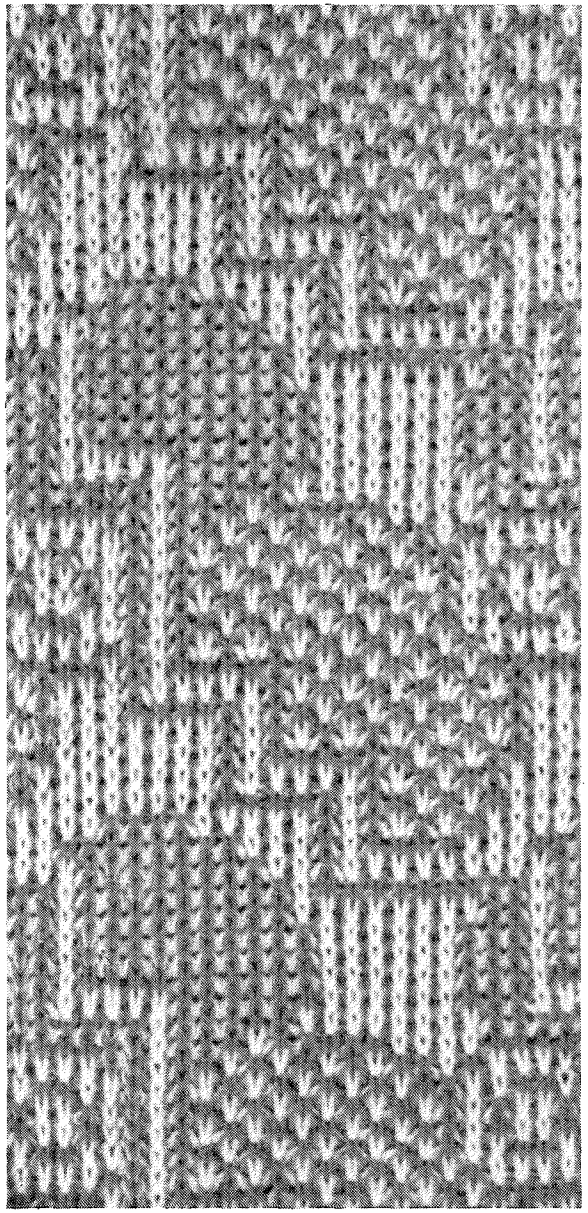
In addition to use of the switches, there are other means of affecting patterning. The following are examples.

If the right cursor stop is eliminated (fastened at the right end of the bed) and the cursor is placed at the right side of the carriage continuously, needle selection for patterning will occur only when the carriage moves left to right. When the carriage moves right to left, all needles will act according to the cam setting. The left cursor stop is placed at the left side of the knitting as usual. This set-up is useful for certain types of double bed fabrics.

Pressing the knit key on the carriage will override all the actions of switches 2, 3, 4, no matter what the setting, and will knit all needles plain. The "N" on Passap, "plain" on Brother/Knitking, and "stockinette" on Singer/Studio serve the same override function.

In this book, the geometric pattern card is grouped with punchcards for other machines. "Punching out a hole" means to blacken a square, and unless otherwise stated, to use the positive reverser. You should note that the majority of fabrics in this book can be used with the decorative pattern cards as well.

CHAPTER 4
Jacquard Punchcards



The concept behind a punchcard is relatively simple. The punched holes in each horizontal row cause corresponding needles to be selected into patterning position and to knit; the unpunched spaces cause the remaining needles to stay in working position and act according to the cam setting. After the basic multi-use punchcards—those punched in all-over patterns, such as 1x1, 2x2, 2x3, and so on—the most popular cards by far are those for jacquards. They will knit two to four colors per pattern row in flat, textured, or relief fabrics, and are often used in one-color knitting for lace and relief fabrics.

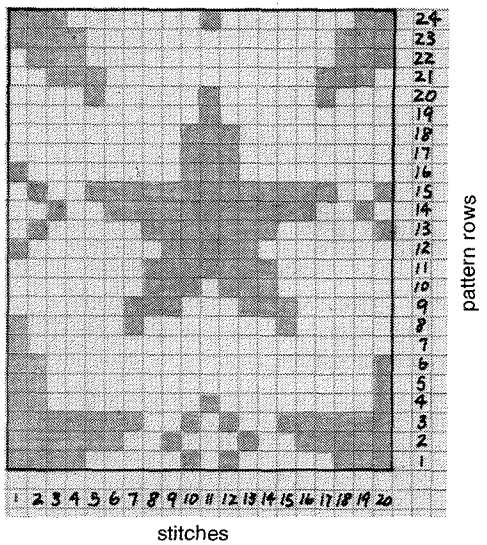
Jacquard cards are used to create the fabrics described in several different chapters in this book. For this reason, the various ways of punching them are explained in this chapter rather than in the Jacquard chapter. There are other types of cards for specific kinds of knitting: intarsia, short rows, and lateral transfer lace. They will be explained in the chapters on those fabrics.

For purposes of easy identification, we have given the letter designations A, B, C and D to the four basic *types* of punchcards described below. Each *pattern* illustrated for these cards is identified by a number. Punchcard types and patterns are referred to by these designations throughout the book.

TYPES OF JACQUARD PUNCHCARDS

Card Types A, B, C and D are general purpose jacquard punchcards for knitting a pattern which repeats both lengthwise and widthwise, or for knitting isolated motifs or panels making use of isolation cams. In each chapter are cam charts which indicate which Type of card is to be used for a particular fabric, and its rotation for each machine.

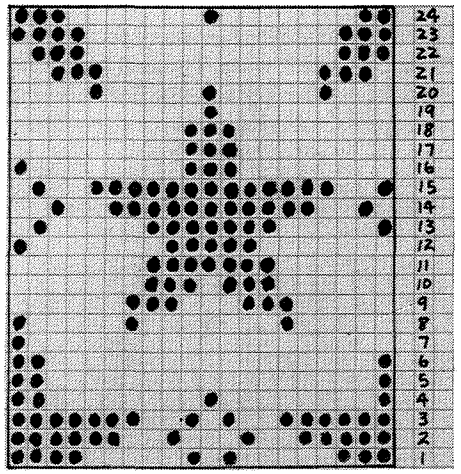
Jacquard Pattern 9 is used here as an example for punching the various types of cards. The numbered pattern rows of the original design are also used on the graphs of the punchcards to prevent mistakes in translating the original charted pattern to a particular punchcard type. The color symbols on the graphs represent holes on the actual card. Note that the examples are for a width of 20 stitches and are shown one repeat wide and one repeat tall on the punchcard graph. Those of you with Japanese machines must refer to the 24-stitch version in the pattern section and punch your cards one repeat wide. Those of you using Passap must punch two 20-stitch repeats. For Superba, three 20-stitch repeats must be made on a geometric card.



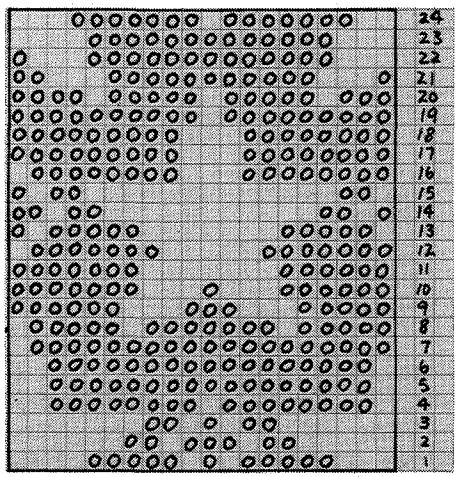
Jacquard Pattern 9, an example for punchcard Types A, B, and C.

TYPE A JACQUARD PUNCHCARD

This is the most common type of jacquard card. It knits two colors per pattern row, and has one punched row for each pattern row. It is used on Passap and Superba machines for nearly all kinds of jacquard knitting in one or two colors, and on the Japanese machines for jersey jacquard, mosaic, ripple, weaving, and some lace patterns. There are two variations of the Type A card. With Type A-1, the design is punched out. With Type A-2, the background is punched out. On Japanese machines, the Type A-2 card can be used for ripple and mosaic patterns. In jacquard knitting, one of the colors knits the stitches corresponding to the punched spaces; the other color knits the stitches corresponding to the unpunched spaces. This is the only punchcard type in which non-punched spaces represent one of the two colors.



Punchcard Type A-1. Punched holes for design. Two colors per pattern row; one punched row per pattern row.



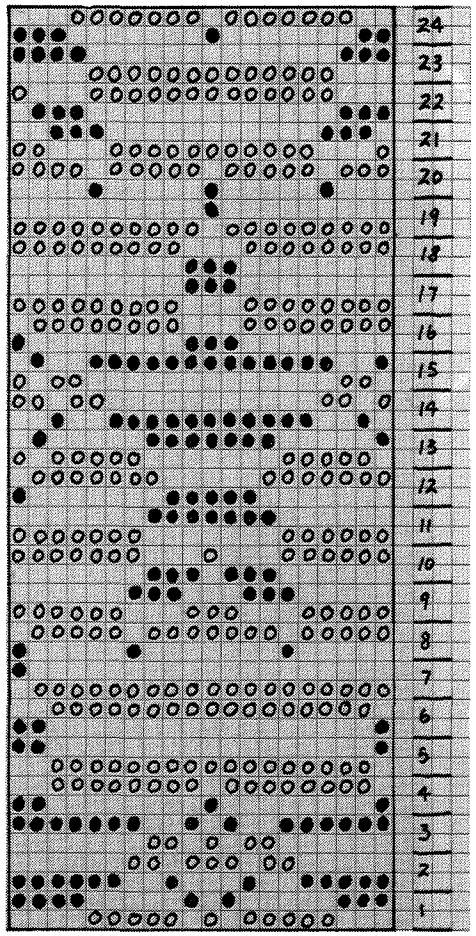
Punchcard Type A-2. Punched holes for background. Two colors per pattern row; one punched row per pattern row.

TYPE B JACQUARD PUNCHCARD

This card knits two colors per pattern row, and has two punched rows for each pattern row. These cards are for the Japanese machines only, for rib jacquard knitting requiring *one knitted row per pattern row.* The card is set to rotate every row (ER), and since the color changer is used, the preparation row is left to right, with main color. Note that each pattern row alternates. On the odd-numbered rows, the background is knitted first, then the design; on the even-numbered rows, the design knits first, then the background. Each punched row knits once, with color change every RC2. This card may also be used with rotation set every other row and color change every RC4, in which case the preparation row is right to left.

This method can be used with Superba machines, with the "Norwegian jacquard" setting on the selection box (switch 3 in upper position). The Type A card is used, and the selection box automatically reverses the selection. The card rotates while the carriage is at right, and the color is changed while the carriage is at left. Complete directions are in the Superba instruction manual.

This kind of knitting cannot be done on Passap with a punchcard because the card reader will not rotate every row, and the Deco cannot select pushers when moving left to right. However, it can be done with manual selection of pushers.



Punchcard Type B. Two colors per pattern row; two punched rows per pattern row.

On the punchcard diagrams shown on these two pages, punched holes which will knit the main color are represented by open circles. Those which will knit the contrast color are represented by closed circle.

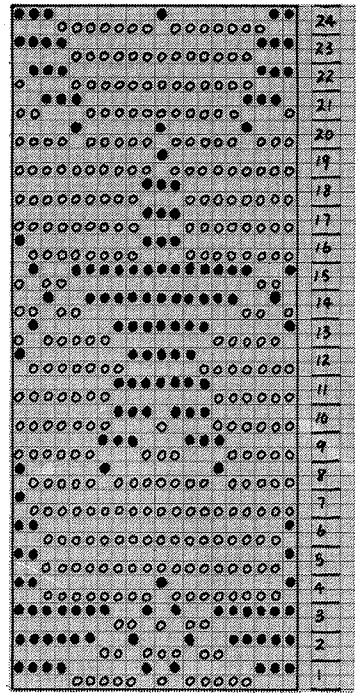
TYPE C JACQUARD PUNCHCARD

This card knits two colors per pattern row. Either two or four punched rows are required for each pattern row.

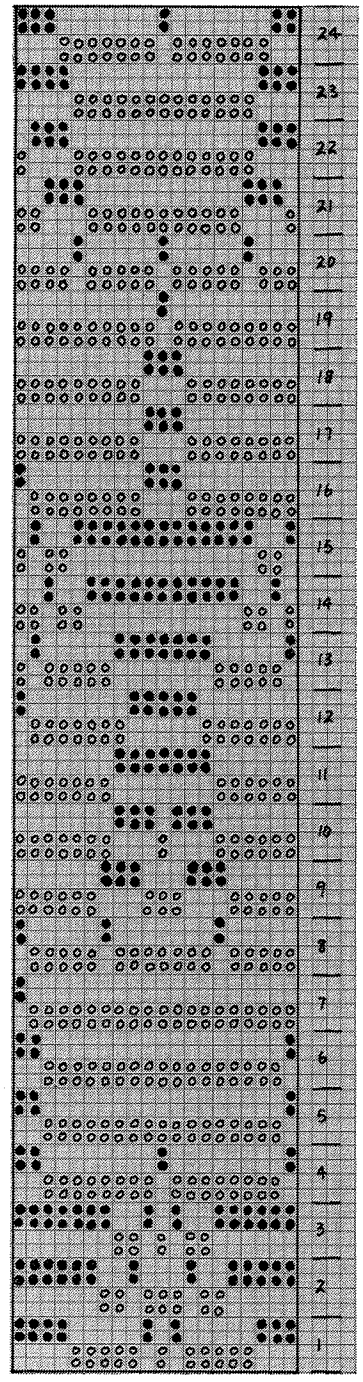
With Type C-1, there are two punched rows per pattern row. The C-1 card is used with Japanese machines for rib jacquards requiring *two knitted rows per pattern row.* The card is always set to rotate every other row (EOR), and the preparation row is right to left. Each punched row knits twice, with the color change every RC2. In each pattern row, the background always knits first, then the design. This card also is used with Passap and Superba, with the Deco set at either 2 or 4, and the selection box rotating the card EOR, as on the Japanese machines.

The Type C-2 card requires four punched rows per pattern row. All machines use this card when it is necessary to knit additional rows with the same needle selection, as in ripple patterns. It is punched like Type C-1, except that two successive rows are punched identically. On the Passap, with the Deco set at 4, eight rows can be knitted without stopping the card. On Superba and the Japanese machines, four rows can be knitted—a convenience in ripple knitting. On the Japanese machines, the preparation row and rotation are the same as with Type C-1 cards, and this card can be used as a C-1 card with the rotation set ER.

With Superba, there is an alternative to using the Type C card. The Type A card can be used with the row advance stopped (switch 4, lower position). Knit the required number of rows with color 1 and the positive reverser, then the required number of rows with color 2 and the negative reverser. Proceed to the next pattern row by pulsing switch 5 once in the appropriate direction and repeat.



Punchcard Type C-1. Two colors per pattern row. Two punched rows per pattern row.



Punchcard Type C-2. Two colors per pattern row. Four punched rows per pattern row.

TYPE D JACQUARD PUNCHCARD

This card knits three or four colors per pattern row, and requires three (if three colors are used) or four (if four colors are used) punched rows per pattern row. The card is punched, and knits, according to the same principle as Type C-1. It can be used for both jersey and rib jacquard on all machines. This card must be used when knitting with more than two colors per row. Each color is knitted in turn and has its own punched row within each pattern row sequence. As shown in the diagrams, three or four punched rows are required for each pattern row, and each punched row knits twice (card rotation is EOR on all machines). The color changer is threaded in the same order as the punched color sequence on the card. It is best to have the main color (background color) either first or last in each sequence. In these punchcard diagrams, the MC is the last color to knit each sequence. Note that in the three-color Pattern 13, color 2 is not represented in pattern rows three and four. Rather than omitting these color 2 rows on the card, simply leave them blank. Then the color change sequence will not be broken and the backing, if knitted double bed, will remain the same throughout.

PASSAP: ISOLATION WITH A TYPE D CARD

The Passap catalog offers a few specially punched cards for knitting rib jacquard isolated motifs with 3 or 4 colors per row, using isolation pins. Here is how these cards work: The isolation pins are arranged to isolate the motif just as in 2-color patterning. Each time a new row is selected, the Deco will automatically send to rest position the pushers in the isolated areas each side of the motif. In 2-color work, these isolated pushers are automatically moved into WP to knit the main color (background color), together with the RP pushers within the motif area. This happens because the standard cam setting on the MB is BX with the left arrow key. The arrow key causes *all* the RP pushers to reverse to WP and to knit. Remember, a Type A card is used for 2-color jacquard on Passap.

When knitting three and four colors per row, with the Type D card, the standard jacquard cam setting is BX without an arrow key. This means the isolated RP pushers outside the motif area never have a chance to reverse to WP to knit unless they are manually brought to WP once each sequence—whenever the main color knits.

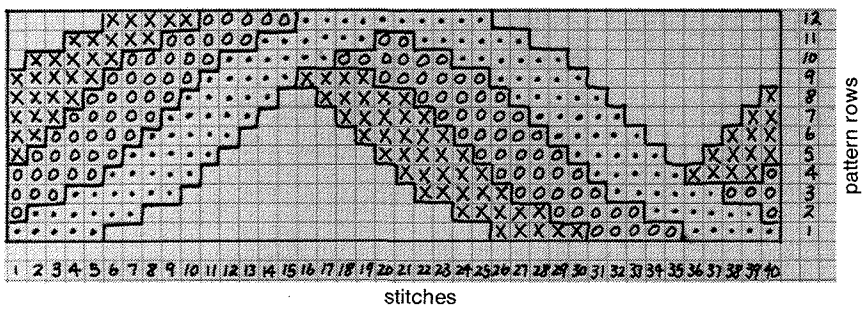
Since it is easier to press and cancel an arrow key than it is to bring pushers manually to WP once each sequence, the punching of the row for the MC is altered to allow the use of the left arrow key, on this punched row only, to bring *all* RP pushers to WP. To do this, the main color (the first or last color in each pattern row) is punched in reverse: on the card, the spaces which represent the main color are *not* punched, while all the other spaces *are* punched. The left arrow key is used whenever this row is knitted in each sequence, and is cancelled for all the other colors in each sequence. It's a good idea to mark an arrow on the card for each of the main color rows.

color 1 - • *(light)*

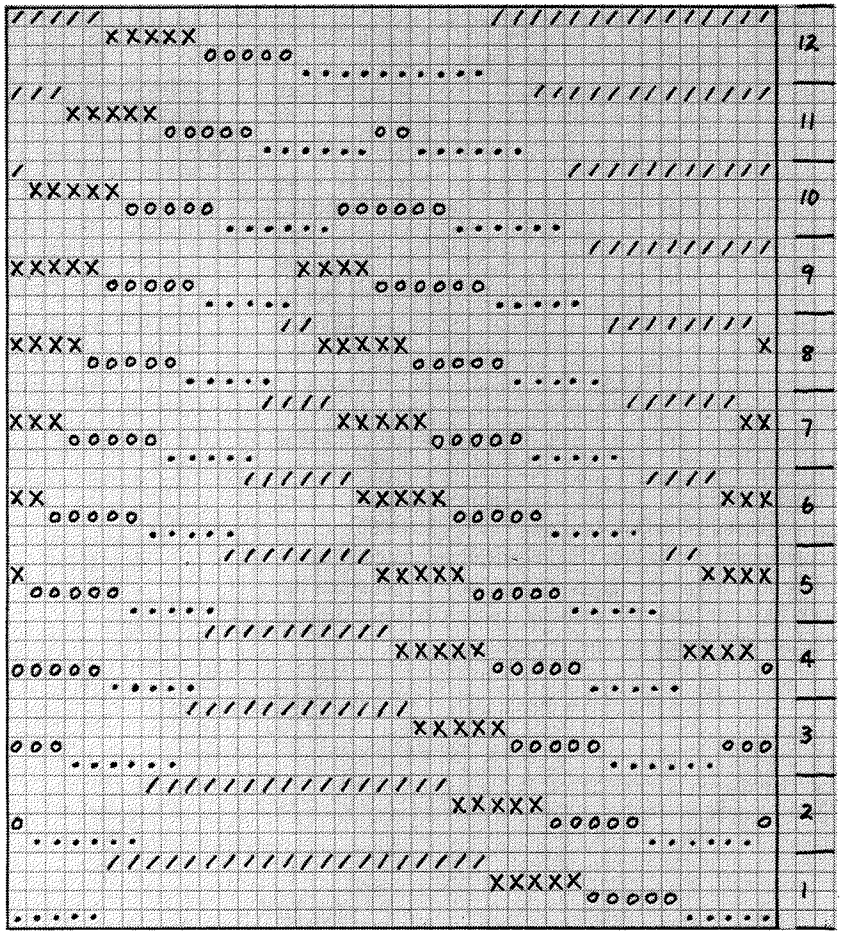
color 2 - o *(medium)*

color 3 - X *(dark)*

color 4 - unmarked squares on pattern; / *on punch-card.*



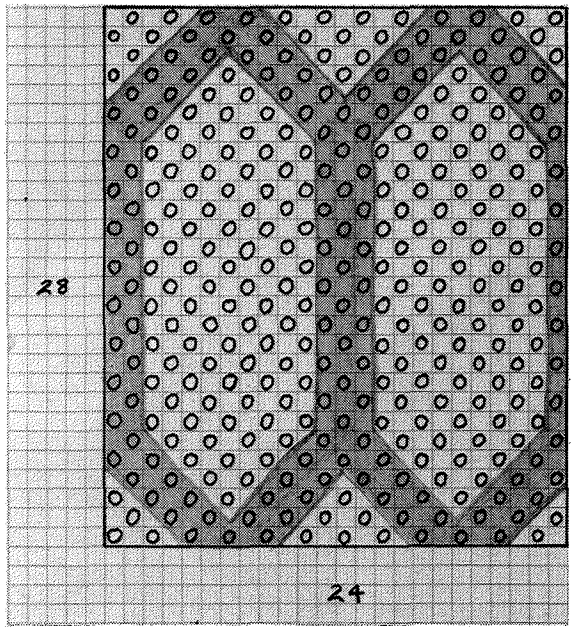
Jacquard Pattern 14, an example for punchcard Type D.



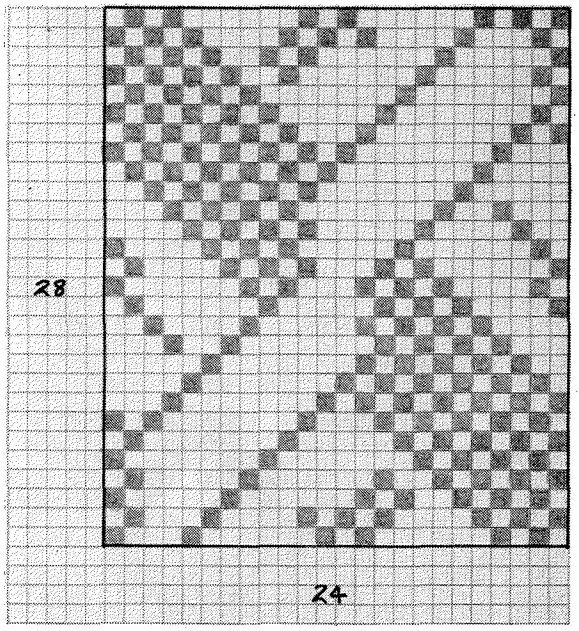
Punchcard Type D. Three or four colors per row; three or four punched rows per pattern row. Punch all spaces marked with a color symbol.

A SELECTION OF JACQUARD PATTERNS

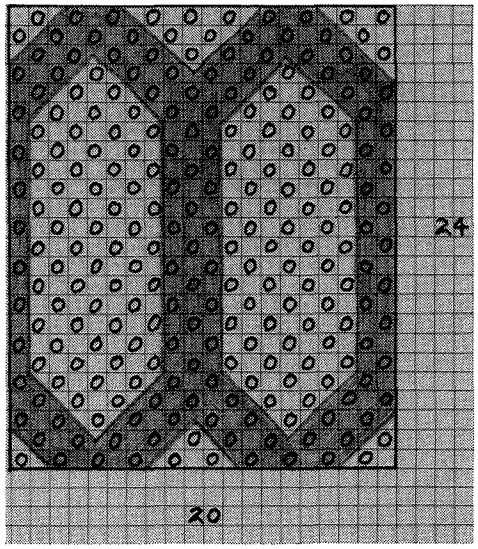
Following is a sampling of jacquard patterns. We have numbered them for purposes of identification, and will refer to them in other chapters throughout the book. Note that the examples are in graph form, and each is shown in a 20-stitch and a 24-stitch version, one repeat wide and one repeat tall. The stitch width is given at the bottom and the number of pattern rows at the side.



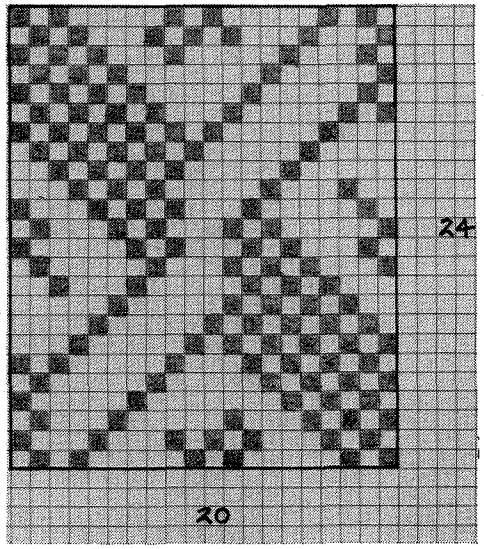
Jacquard Pattern 1, for Brother/Knitking and Singer/Studio. 1x1 basic card, with holes taped over for pattern.



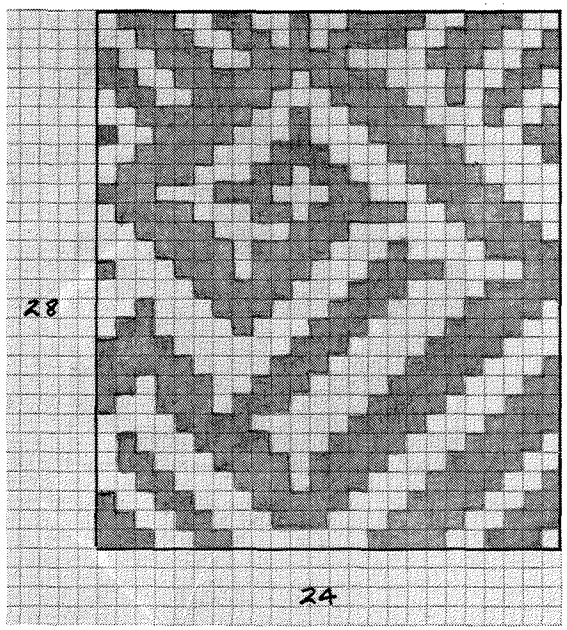
Jacquard Pattern 2, for Brother/Knitking and Singer/Studio.



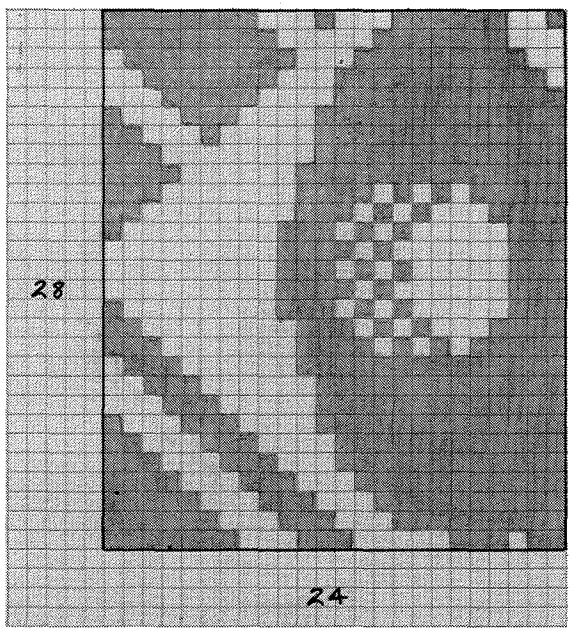
Jacquard Pattern 1, for Passap and Superba. 1x1 basic card, with holes taped over for pattern.



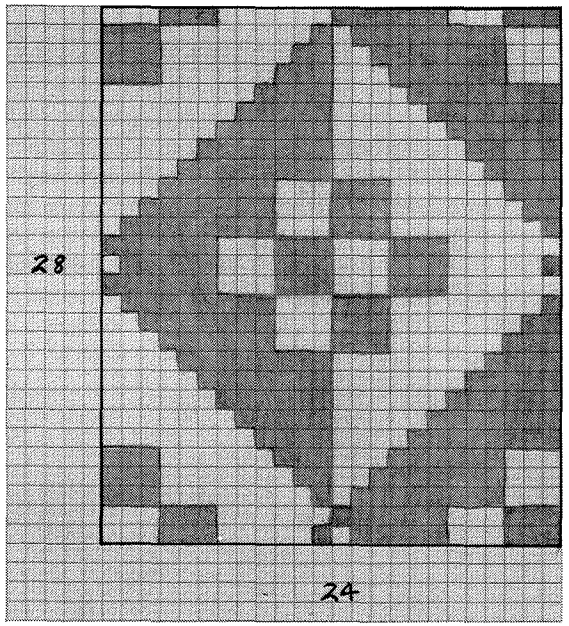
Jacquard Pattern 2, for Passap and Superba.



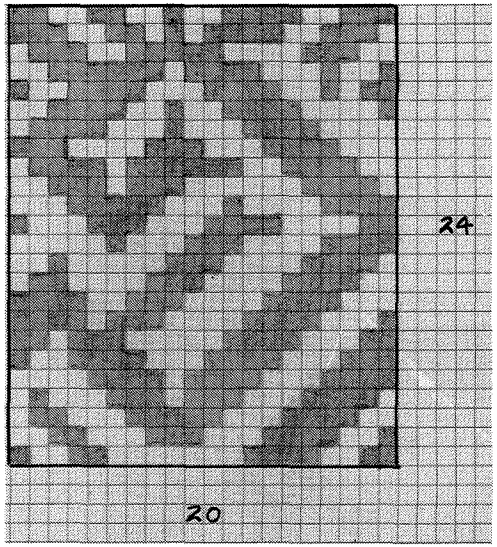
Jacquard Pattern 3, for Brother/Knitking and Singer/Studio.



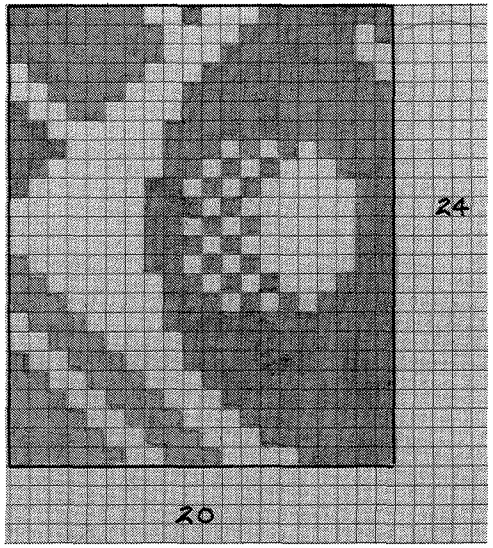
Jacquard Pattern 4, for Brother/Knitking and Singer/Studio.



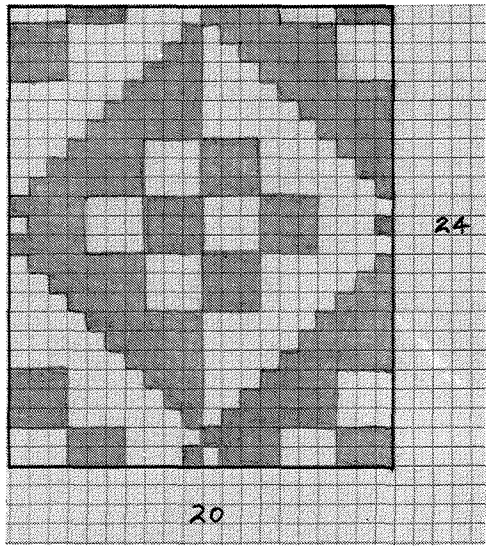
Jacquard Pattern 5, for Brother/Knitking and Singer/Studio.



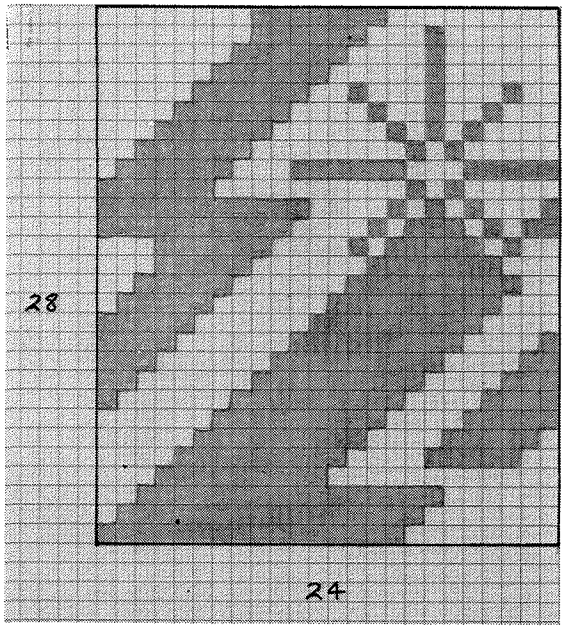
Jacquard Pattern 3, for Passap and Superba.



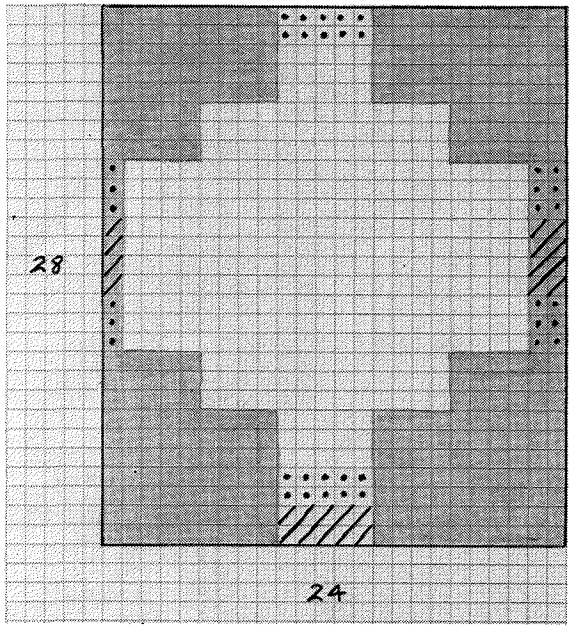
Jacquard Pattern 4, for Passap and Superba.



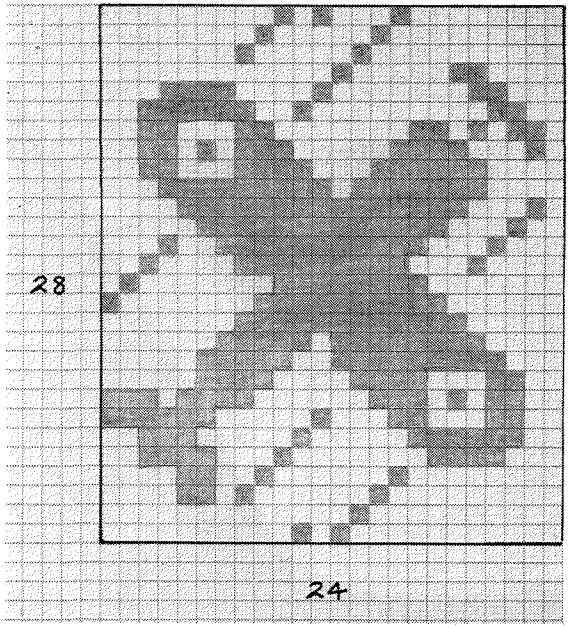
Jacquard Pattern 5, for Passap and Superba.



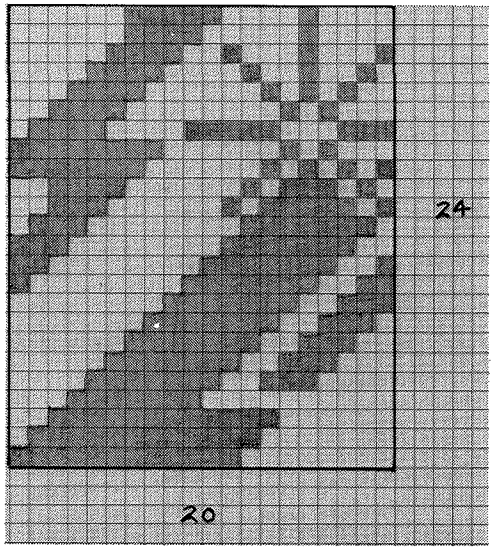
Jacquard Pattern 6, for Brother/Knitking and Singer/Studio.



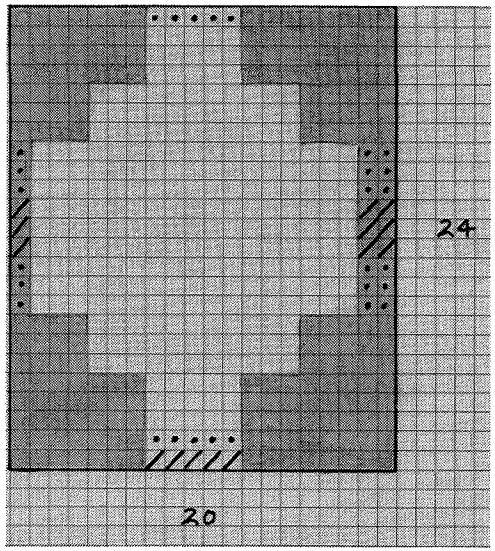
Jacquard Pattern 7, for Brother/Knitking and Singer/Studio. Symbols indicate suggested color change.



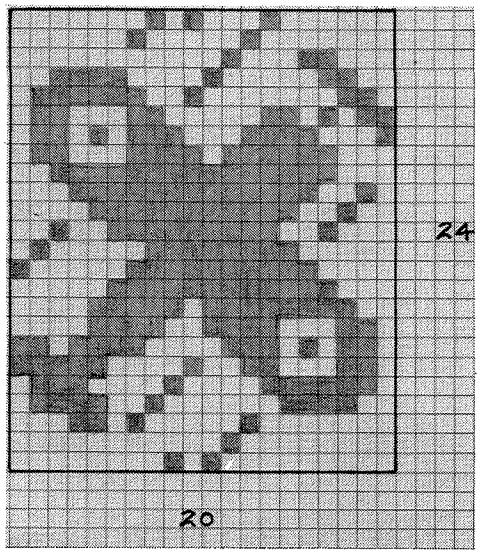
Jacquard Pattern 8, for Brother/Knitking and Singer/Studio.



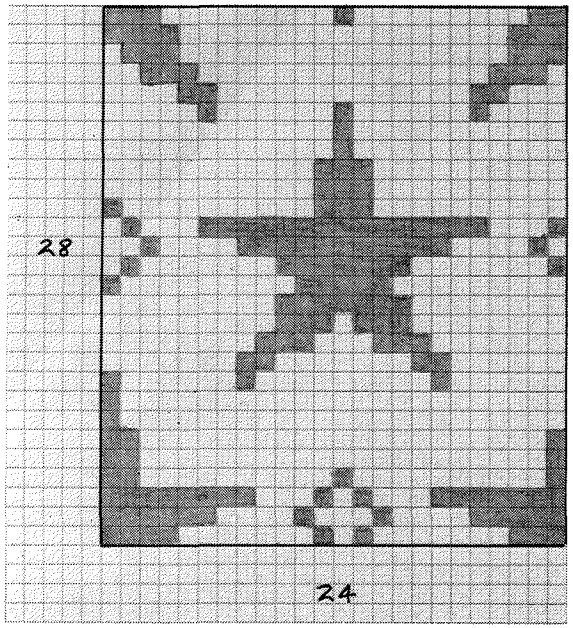
Jacquard Pattern 6, for Passap and Superba.



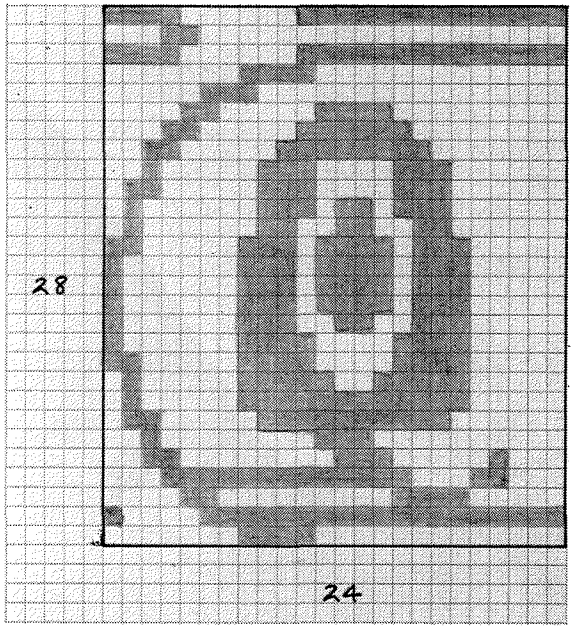
Jacquard Pattern 7, for Passap and Superba. Symbols indicate suggested color change.



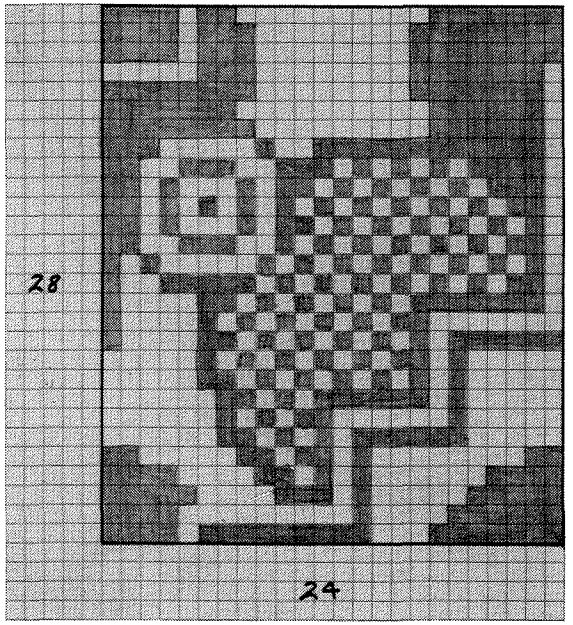
Jacquard Pattern 8, for Passap and Superba.



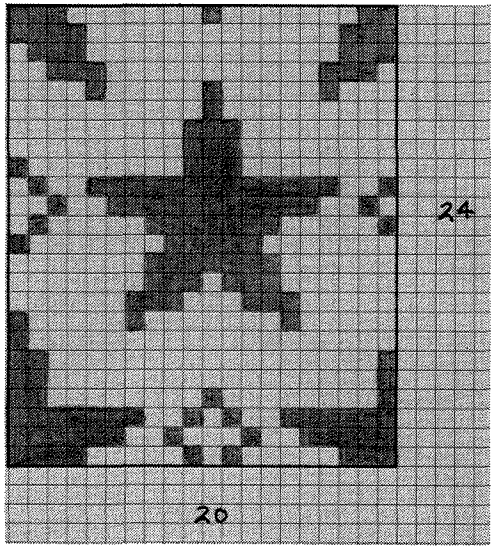
Jacquard Pattern 9, for Brother/Knitking and Singer/Studio.



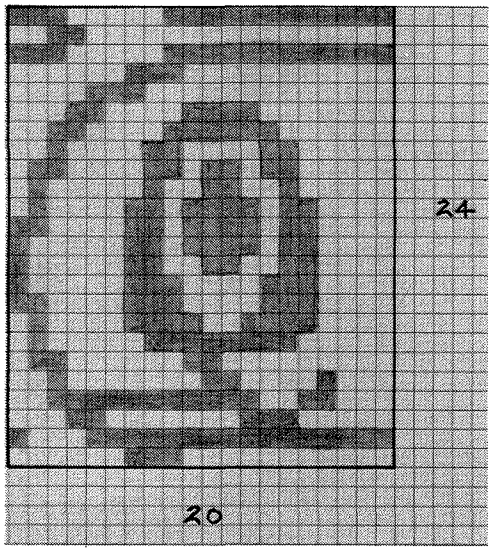
Jacquard Pattern 10, for Brother/Knitking and Singer/Studio.



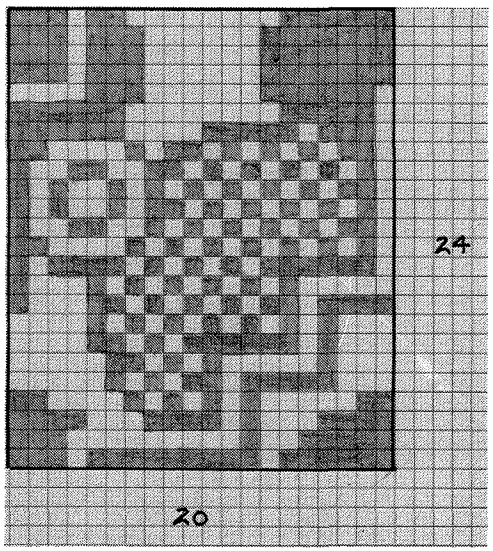
Jacquard Pattern 11, for Brother/Knitking and Singer/Studio.



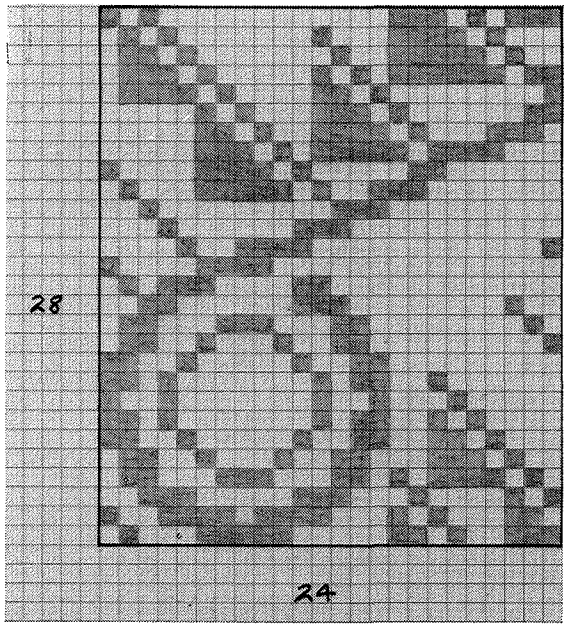
Jacquard Pattern 9, for Passap and Superba.



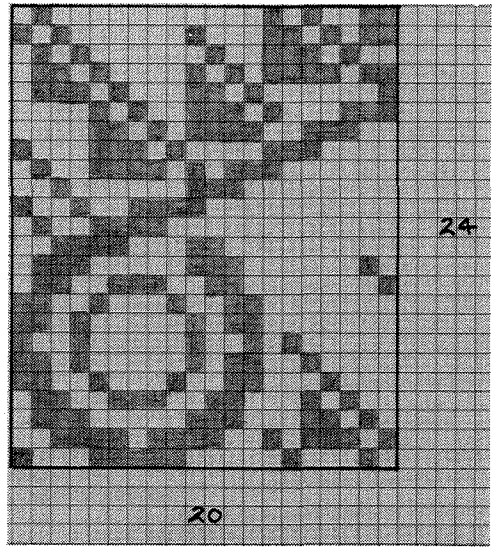
Jacquard Pattern 10, for Passap and Superba.



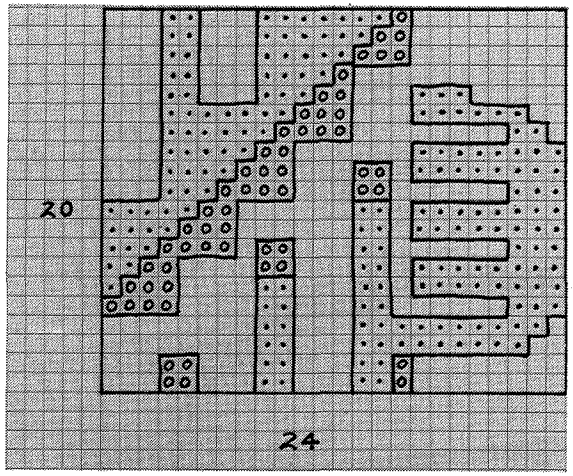
Jacquard Pattern 11, for Passap and Superba.



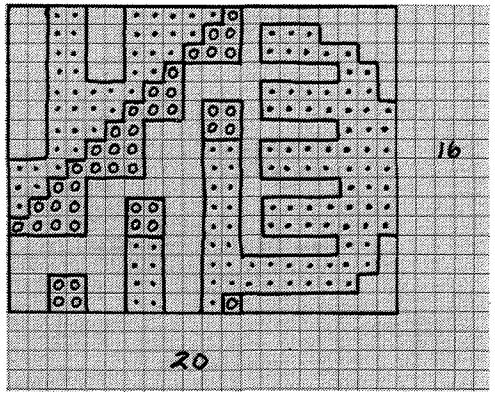
Jacquard Pattern 12, for Brother/Knitking and Singer/Studio.



Jacquard Pattern 12, for Passap and Superba.



Jacquard Pattern 13, for Brother/Knitking and Singer/Studio. Three colors per pattern row.



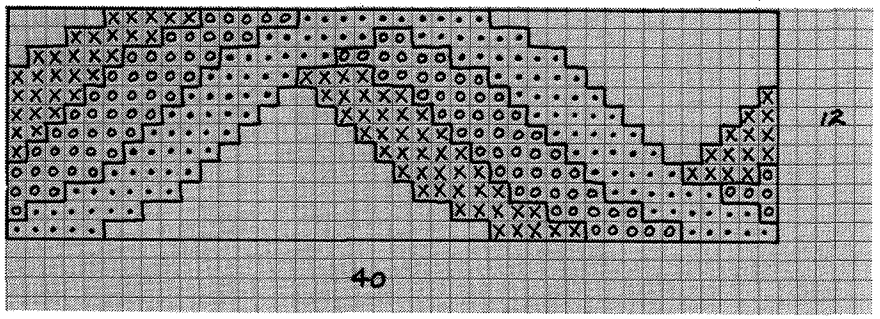
Jacquard Pattern 13, for Passap and Superba. Three colors per pattern row.

color 1 - • (light)

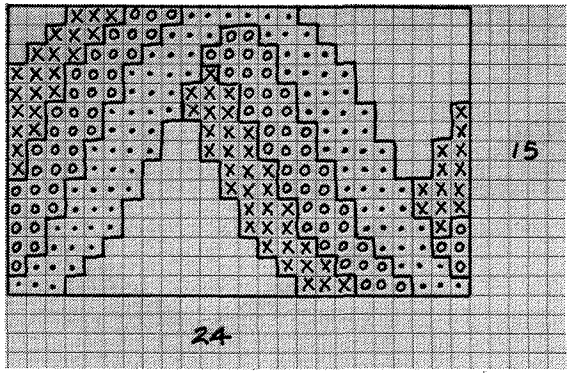
color 2 - o (medium)

color 3 - X (dark)

color 4 - unmarked squares

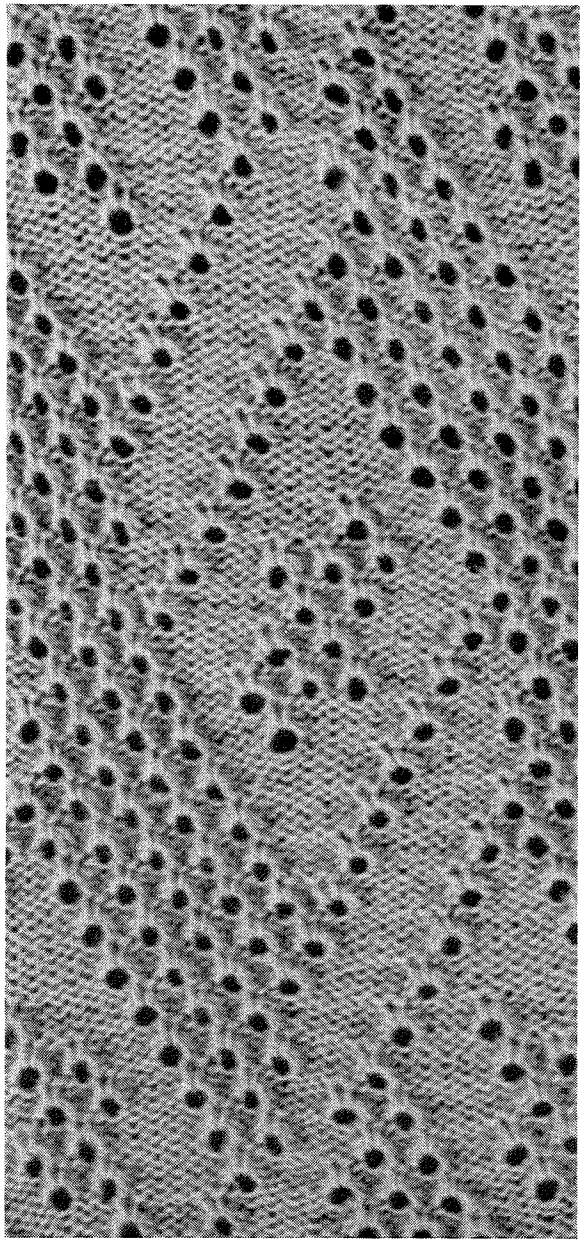


Jacquard Pattern 14, for Passap. Four colors per pattern row.



Jacquard Pattern 14, for Brother/Knitking and Singer/Studio. Four colors per pattern row.

CHAPTER 5
Accessories



Here we discuss accessories which are used in this book. Included are manual patterning devices, color changers, and the various special carriages. Charting attachments are not included, although their use is mentioned in several chapters, because they are concerned more with garment design and fabric patterning than with fabric structure. The lateral transfer carriages and intarsia carriages will be discussed in the appropriate chapters.

THE COLOR CHANGER OR AUTOMATIC YARN CHANGER

Each of the four machines has some sort of device for holding at least two ends of yarn in such a way that they can be exchanged quickly and conveniently, at frequent intervals, for pattern knitting. The exchange takes place automatically or semi-automatically. In nearly all color knitting, the placement of the color changer on the machine (at left or right) determines the starting position of the carriage for the knitting sequence. The color changer is used in single feed color knitting, where only one yarn is knitted at a time and must be exchanged with another at frequent intervals, say, every two rows. It is not used where the double feed system of color knitting is used, as in jersey jacquard and in some intarsia methods, and some rib jacquards on Superba.

On Passap, a 2-color changer is part of the basic equipment. It is installed at the right end of the needle bed. A 4-color changer can be purchased as an accessory. Superba does not yet have a color changer; its yarn changing device is the "Jac Claw," a fork-shaped attachment which is mounted on the left side of the carriage. It holds two yarns, which must be exchanged manually and placed in the carriage. It is part of the machine's basic equipment.

Four-color changers are also available as accessories for Brother/Knitking and Singer/Studio. They are mounted on the left end of the needle beds and are used for double bed color knitting. Brother/Knitking also has another model, for single bed color knitting, but it is not used in this book. The two double bed yarn changers can be used for single bed knitting as well, such as in single bed mosaic patterns and some of the intarsia methods. The procedure is as follows: attach the ribber arm to the main bed carriage as usual. After casting on, put the ribber up in its normal working position but remove the ribber carriage or put it out of the way at one end of the beds. If you have a ribber cover, put it on, then proceed with the knitting. Since the ribber arm must be used instead of the usual sinker plate for the main carriage, the ribber sinker posts must replace the action of the brushes and wheels; that is, hold the knitting against the main bed during stitch formation. Put claw weights on the selvedges, and knit a little more slowly than usual. Any problem needles can be brought to HP to ensure that they knit properly.

THE JAC 40 AND PATTERN RULERS

The Jac 40 is the predecessor of punchcard systems on modern knitting machines. It is a hand-held, rectangular punchcard holder with a row of 40 retractable "teeth" along one side. A 40-stitch wide punchcard is fed into it; the teeth protrude through the holes on each punched row and select needles or pushers exactly as a pattern ruler does. After a pattern row has been knitted, a handle advances the punchcard to the next row.

There are two types of Jac 40s. They look and function alike, but one has teeth spaced 5 mm apart, for the European machines; the other has teeth 4.5 mm apart, for the Japanese machines. There are even 4-mm Jacs around, for the really old knitting machines. The Passap Jac (5 mm) is still available, as are blank and patterned punchcards for it. The Jac for Japanese machines is more difficult to find, as are its punchcards, because automatic punchcard systems on Japanese machines have been available longer than have those for Passap.

You can make your own cards for a 4.5 mm Jac by using the blank Passap Jac cards, the old, unperforated blank Deco cards, or the current perforated blank Deco cards. The Deco cards must be trimmed about 1 cm on each side to fit into the Jac. You will need to prick guide holes with 4.5 mm spacing for the punch. Use a blank 24-stitch punchcard as a pattern, and use the Passap puncher to reach into the center of the card

for punching the holes. This Jac also can be used on the 9-mm bulky machines.

The Jac 40 is a most useful tool with all the machines. It can be made into an adjustable pattern ruler, when used without a punchcard, simply by taping down some of the teeth. Or you can punch a card with different, commonly used, needle selections on each row, then choose the one you need for the task at hand.

When fitted with a punchcard identical to the one on the main bed, it can be used to select needles on the second bed for reversible patterning. For Japanese machines, punch out one edge of the 40-stitch card for a 24-stitch repeat, and save the remaining 16 stitches for an 8-stitch pattern. One edge or the other can be covered with a piece of paper taped onto the card to block the teeth, depending which edge of the card you want to use. Or, the Jac 40 can be used on both beds simultaneously with one 40-stitch punchcard.

Two different patterns can be knitted on the same bed together. By using a regular punchcard in the reader, and isolating portions of the needle bed with isolation cams, the Jac can be used in the isolated areas to select needles for a second pattern.

A non-repeating pattern as wide as the whole bed can be knitted by dividing each pattern row into 40-stitch sections and putting each section on successive punched rows. For example, if the pattern is two-color jersey jacquard, five punched rows are required to select the needles all the way across the bed for one pattern row.

It helps to mark the needle bed with a grease pencil where the edges or center of the Jac will be placed for the needle selection on each row. This prevents errors caused by accidental shifting of the Jac. To do this on Passap, paint the front of the *stems,* not the butts, of several pushers with nail polish; these can be interchanged with unmarked pushers to identify the center of each selection and can be kept at one end of the bed when not in use. Use of the Alinea attachment for the main bed on Passap is highly recommended for those occasions when the Jac is used without the Deco. It automatically lines up the pushers in working position at the end of each pattern row in readiness for the next selection.

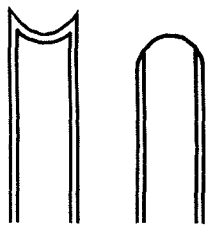
PATTERN RULERS

A collection of pattern rulers in various configurations is almost indispensible for manual selection of needles. They can be used for quick needle set-up, for selecting needles on the second bed in rib jacquard, tubular, and reversible fabrics, and for very simple or experimental patterning on the main bed.

At least one pattern ruler comes with every new knitting machine, usually one with a straight edge on one side and teeth in 1x1 selection on the other. Others may be supplied, or can be purchased as accessories. Especially useful are those in 1x3 and 3x1, 1x2 and 2x1, and 2x2 selection. Also available are adjustable pattern rulers which allow you to set up your own configuration, or a Jac 40 can be used for this purpose. You also can make a pattern ruler from a piece of stiff cardboard. One edge can be crenelated with a mat knife into whatever configuration you need, or it can be crenelated on all four sides for a four-row repeat. The photo on the last page of this chapter shows a selection of pattern rulers.

MODIFIED BLADES FOR PASSAP'S BLACK STRIPPERS

From the Passap manufacturers comes a helpful suggestion for knitting certain fabrics where black strippers are needed and where there are long floats or yarn ends across the knitting, as in intarsia, short rows, or weft knitting. Sometimes the floats get caught in the blade ends. To prevent this problem when knitting these fabrics, buy an extra set of blades and round off the ends with a file. They then will pass smoothly over the knitting.



Modified blades for Passap: before (left) and after (right).

THE CROSS BED TRANSFER CARRIAGES

To transfer a stitch cross bed means to move it from a needle on either the front or back bed to an opposite needle on the other bed. Cross bed transfer accessories are available on all four machines. They run the gamut at present, from a multidecker pair of "jaws" to a special carriage for automatic selective transferring. These accessories are very useful in creating many of the fabrics discussed in the Embossing chapter and in the Lace chapter.

The chart on the next page summarizes the capabilities of the cross bed transfer carriages. It will help determine the feasibility of using one or another to create a particular fabric. Following is a more detailed discussion of the capabilities of each one.

Successful stitch transfer—wherein the transferred stitch lands in a needle hook on the opposite bed rather than in the air—depends first on proper adjustment of bed spacing and pitch, and then on yarn size and elasticity, stitch size, and weights. These four factors are not necessarily the same for every fabric and every type of transfer for each carriage; there may or may not be a range of tolerance. The only sure way to know is through experience. If you keep careful notes on every swatch you make utilizing your transfer carriage, you will soon build a repertoire of fabrics encompassing the features and capabilities of your carriage. First, *read your instruction booklet carefully,* and *practice* every type of stitch transfer it suggests. If you do this much before attempting the fabrics in this book, you will have the initial experience you need. The discussion here is a synopsis of capabilities, not instruction for use.

The Shadow Lace Transfer Tool is not a carriage, and therefore is not included in the discussion below. It is a hinged 20-decker tool used with the Japanese machines. It is operated manually, and can transfer 20 stitches at a time from one bed to the other. It is particularly useful for transfers from the main bed to the ribber, or in either direction when using fine, fragile, or non-stretchy yarns which would break under the strain of a transfer carriage. Because it is manually operated it is also the most versatile in capability, albeit the slowest.

CAPABILITIES OF THE CROSS BED TRANSFER CARRIAGES

	Transfers FB to BB	Transfers BB to FB	Transfers all ndls regardless of selection	Transfers selected ndls	Transfers to ndls with stitches	Transfers to single empty ndls	Transfers to adjacent empty ndls	Left transfer (FB to BB)	Right transfer (FB to BB)
Passap U-70	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes
Passap U-80	Y	Y	Y	Y	Y	Y	Y	Y	Y
Superba lace carr	Y	Y	Y	N	Y	Y	N	Y	Y
Superba garter carr	Y	Y	Y	Y	Y	Y	Y	Y	Y
Brother/Knitking KA 8300 ribber transfer carr	Y	N	Y	Y	Y	Y	Y	Y	Y
Singer/Studio RT-1 ribber transfer carr	Y	N	Y	Y	Y	Y	Y	Y	Y
Singer/Studio shadow lace tool can be used on Brother/Knitking	Y	Y	Y	Y	Y	Y	Y	Y	Y

TRANSFERRING BETWEEN BEDS

All carriages will transfer from front bed to back bed, but only the European carriages will transfer from back bed to front bed. Be careful, with all carriages, to move them only in the prescribed direction and from the correct end of the beds. The direction is usually marked with an arrow on the top of the carriage. On all machines, the carriage is moved right to left to transfer from front to back bed, and, on the European machines, left to right to transfer from back to front bed. Care must be taken that there are needles in WP on the bed to *receive the transferred stitches,* otherwise the stitches will transfer into the air. The exception is the Superba garter carriage, which uses this principle for selective transfer in patterning. With all carriages, be sure that the stitch size is adequately large on the last row before transfer. Note that it is not always necessary for the transfer carriages to move the same direction as the main carriage; some transfers are made in the opposite direction.

TRANSFERRING ALL STITCHES AND TRANSFERRING SELECTED STITCHES

All the carriages will transfer every needle in WP across the bed, and all except the Passap U-70 and Superba lace carriage can transfer selectively as well. Since selective stitch transfer is so important in patterning, the details of each carriage's capabilities are given below.

Passap U-70. Transfers all needles in WP. No provision for selective transfer.

Passap U-80. Five different settings for various kinds of transfers.

Settings 1 and 5. Transfer needles with pushers in WP. Needles with pushers in RP or NWP will not transfer.

Settings 3 and 4. Transfer all needles in WP regardless of pusher positions.

Setting 2. The "lili" setting. Automatically selects and transfers every other needle beginning with the second needle the carriage encounters. Pushers must be in RP or NWP. If a pusher is in WP under a non-selected needle, it also will transfer.

Superba lace carriage. Transfers all needles in WP. No provision for selective transfer.

Superba garter carriage. Two settings for two kinds of transfers, which can be used separately or together.

Setting A. The lili setting; automatically selects and transfers every other needle beginning with the second needle the carriage encounters.

Setting B. Transfers all needles in WP.

In patterning, needle selection for transfer is determined by the presence or absence of a needle in WP on the opposite bed to receive the transferred stitch. With either A or B setting, all the working needles will attempt to transfer. If there is a needle in WP on the opposite bed to receive the stitch, the stitch will transfer into its hook. If there is no needle to receive the stitch, it will not transfer but will remain on the closed latch, not in the hook, of the original needle.

Brother/Knitking KA 8300. Two settings for selective or non-selective transfers. With the change lever in lower position, all ribber needles in WP will transfer regardless whether they are in B or D position. With the change lever in upper position, only needles which have been manually selected to D position will transfer.

Singer/Studio RT-1. Selective transfer capability only. Ribber needles manually selected to C position will transfer, those remaining in B position will not. If all needles in WP are to be transferred, they must first be brought to C position manually or with the P carriage.

TRANSFERRING TO NEEDLES WITH STITCHES AND TO NEEDLES WITHOUT STITCHES

All carriages will transfer a stitch to a needle already holding a stitch (occupied needle), and all will transfer a stitch to a single needle without a stitch, as when

transferring 1x1 or 2x1 rib to stockinette. However, not all carriages will transfer stitches to *adjacent* empty needles. There are two basic methods by which different carriages accomplish these transfers: by transferring the needles in consecutive order, or by transferring alternate needles then transferring the remaining alternate needles. Below are the specifics.

Passap U-70. Transfers to needles with stitches or to single needles without stitches. Stitches are transferred in consecutive order.

Passap U-80. Settings will vary, depending whether or not the receiving needles have stitches.

Settings 1 and 3. Transfer to adjacent empty needles. Setting 1 uses pushers while 3 does not. As the carriage passes across it first transfers alternate stitches, then immediately transfers remaining alternate stitches all in one pass of the carriage. The two actions can be separated into two passes of the carriage if desired. If, for example, you are working in garter stitch with setting 3 and the transfer is difficult, you might accomplish the task more easily with two transfers: the first with setting 2, the second with setting 4.

Settings 4 and 5. Transfer to needles with stitches, and to single empty needles. Stitches are transferred in consecutive order. Setting 4 does not use pushers; setting 5 does. Settings 1 and 5 can be interchangeable in many stitch patterns which involve pushers for selective transfer. Use the one which accomplishes the transfer most easily.

Setting 2. The lili setting; transfers to either empty or occupied needles.

Superba lace carriage. Transfers to needles with stitches and to single needles without stitches. Stitches are transferred in consecutive order.

Superba garter carriage. Settings will vary, depending whether or not the receiving needles have stitches.

Setting A. The lili setting; transfers every other stitch to either empty or occupied needles.

Setting B. Transfers to needles with stitches or to single empty needles, in consecutive order.

Settings A and B together. Transfers to adjacent empty needles by first transferring alternate stitches, followed immediately by the remaining alternate stitches, all in one pass of the carriage. If the transfer is difficult, it may be easier to do it in two passes; the first with setting A, then with setting B.

Brother/Knitking KA 8300. This carriage will accomplish all types of transfers, but requires more than one transfer pass except when transferring to stockinette from a 1x1 rib set-up. This is because the carriage will not transfer two adjacent stitches at once. To transfer onto needles already holding stitches, select every other needle to D position, put change lever in upper position, and transfer. Remaining stitches can then be transferred with the change lever down, without selection. The initial selection can be a configuration other than 1x1 as long as there is at least one stitch between selected needles. Three or four passes of the carriage may be required to complete one transfer. The same principle applies when transferring onto empty needles, but the empty needle which is to receive the stitch on the back bed must be adjacent, on one side only, to an already occupied needle. For example, in a wide rib such as 5x5, transferred to stockinette, you would transfer stitches 1 and 5 first, then 2 and 4, and finally 3.

Singer/Studio RT-1. Transfers to needles with stitches and to both single and adjacent needles without stitches. Because of the type of transfer mechanism used by this carriage, the needles can be transferred in consecutive order in all types of transfers. If a transfer is difficult, select alternate needles to C position and transfer, then select the remaining needles and transfer the stitches with a second pass of the carriage.

LEFT AND RIGHT TRANSFERS

For fabrics and stitch patterns *where the knitting is done with the beds in half pitch,* and the transfers are from front to back to occupied needles, a front bed stitch must be transferred to an adjacent back bed needle, either to the left or right. In some stitch patterns, the direction of the transfer, left or right, is very important; in others, it is immaterial. To check which direction is "default" on your machine, knit a swatch with stockinette on the back bed, and every 5th or 6th needle in WP (and knitting) on the front bed, to make an embossed rib. Now transfer the front bed stitches to the back bed, following the instruction booklet for FNR transfer. Note that the beds must be racked before transfer. The direction that the beds are racked will determine whether the transfer is left or right. When the transfer is complete, put the beds in the original half pitch position, then check the rib stitches to see which direction they were transferred. To transfer stitches in the opposite direction, either eliminate the rack, or rack in the opposite direction (this varies with the carriage). With some carriages, this kind of opposite FNR transfer works reliably with all types of fabrics; with others it works only some of the time or not at all. Below is a synopsis.

Passap U-70. The transfer position is with the racking handle at the 9 o'clock position, which puts the beds in quarter pitch. The transfer is made by racking ¾-turn to the left, which makes a right transfer. Put beds back in original half pitch position after transfer. This carriage cannot make a left transfer. Although some of the more recent models of U-70 reputedly are able to do so, ours does not.

Passap U-80. The transfer position is with the beds in quarter pitch, with the racking handle in the 9 o'clock position. It makes both left and right transfers reliably, both front to back and back to front. A left transfer from front to back is made by racking ¼-turn to the right; a right transfer from front to back by racking ¾-turn to the left. In fabrics or stitch patterns where all successive transfers are to the left, the beds can remain in the transfer position during the knitting, thus eliminating the need for constant racking. If both left and right transfers are used alternately on successive rows, the beds can remain in transfer position during knitting, racking left and right from 9 o'clock to 9 o'clock on successive transfers, or they can be put back in the original half pitch position during the knitting between transfers. Generically written directions in this book assume that the rows are knitted with the beds in half pitch.

Superba lace carriage and garter carriage. The transfer position is with the beds in quarter pitch. Place beds in full pitch first, then push the transfer lever back. Makes both left and right transfers reliably, from front to back and back to front. When transferring from front to back, if beds are placed into transfer position from half pitch, the transfer will be to the right. If beds are racked one needle left after placing in

transfer position, the transfer will be to the left. If all transfers are to be in the same direction on successive pattern rows (to the left), the beds can remain in transfer position during knitting, eliminating the need for setting up the transfer position from half pitch. If transfers on successive pattern rows alternate left and right, the knitting can be done with the beds in transfer position, racking alternately left and right before each transfer. In all generically written directions in this book, it is assumed that the knitting is done with beds in half pitch rather than transfer position.

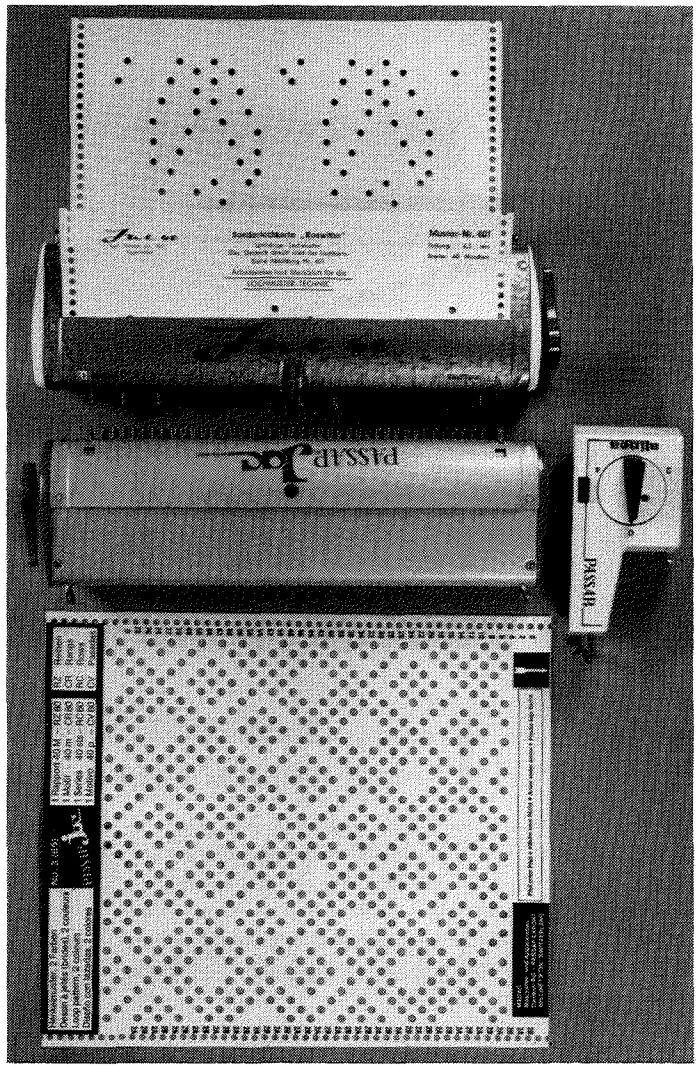
Brother/Knitking KA 8300. The transfer position is with the beds in half pitch. It makes right transfers very reliably, left transfers most of the time. For a right transfer, rack one needle to the right before transfer, then rack back to continue knitting. For a left transfer, do not rack, just transfer. If the stitch size is large enough, there should be very little problem with this transfer.

Singer/Studio RT-1. The transfer position is with the beds in full pitch. Both left and right transfers can be made very reliably. When the beds are placed in full pitch from the half pitch position, by moving the pitch lever to the left, the transfer will be to the left. If the beds are placed in full pitch and then racked one needle to the right before transferring, the transfer will be to the right. In both cases, be sure to place the beds back into the original half pitch position before knitting the next rows.

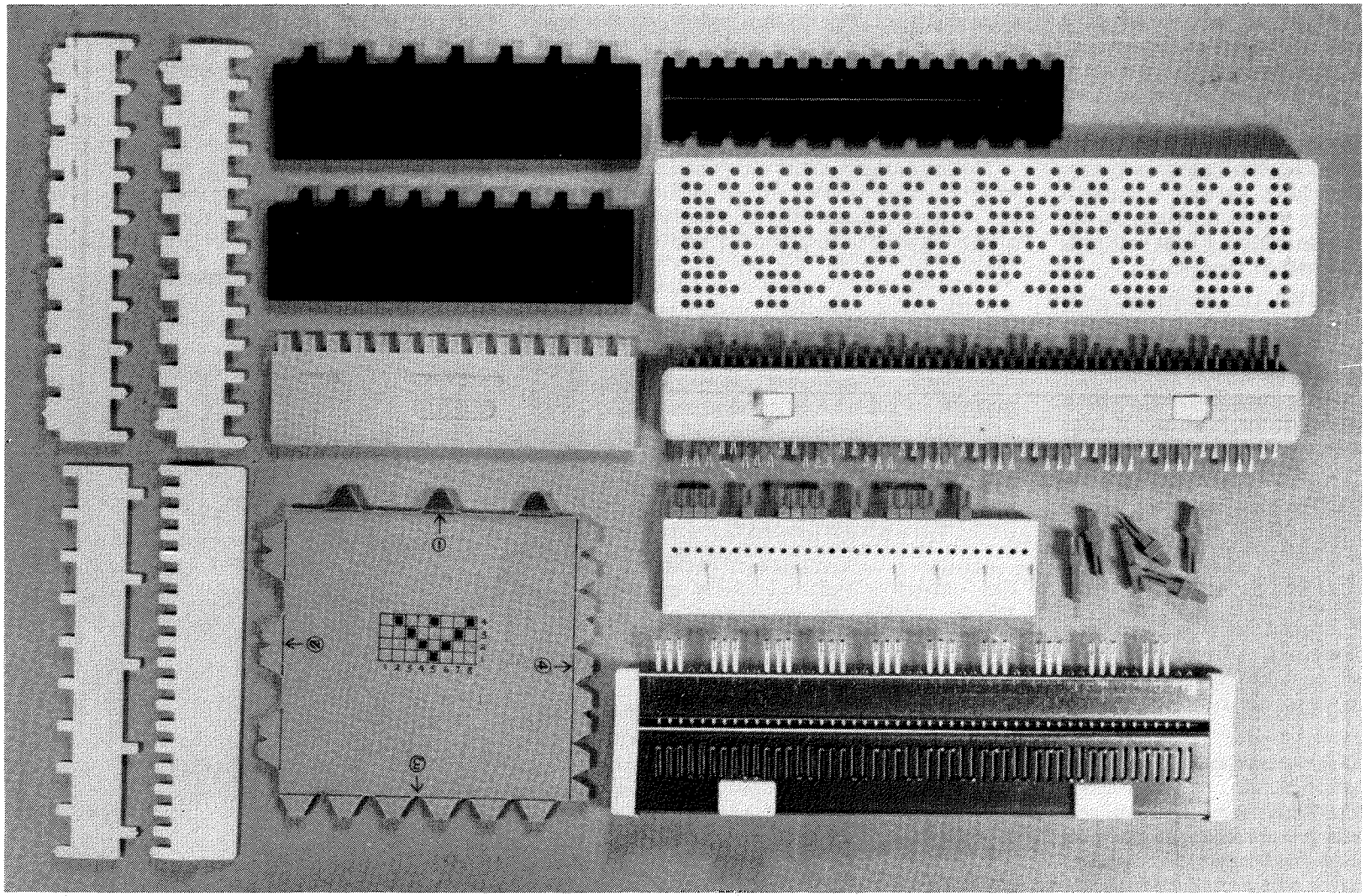
Brother/Knitking G (Garter) Carriage — KG 88 and KG 89.

As of this writing, the G carriage is not yet available in the U.S. We have seen it in operation and have read its instruction manual, but have not yet had a chance to experiment with it. It is not a cross bed transfer carriage, since it is used only with single bed, but it can produce many of the same knit/purl and garter stitch fabrics created with the cross bed carriages. It employs a latch needle, mounted inside the carriage, which faces in the opposite direction from the needles on the main bed, like those on the ribber. With this needle, the carriage takes a selected stitch (determined by the punchcard) from the original needle on the needle bed, slides it onto the latch needle, knits it, then puts it back on the original latch needle as a *knit* stitch instead of the usual purl stitch. This is a slow process, which is why, in this country at least, the carriage has already been dubbed "The Turtle," and why it has built-in amenities which allow the knitter to turn his/her attention elsewhere as the carriage inches its way through a pattern.

The instruction manual and punchcards provided with the carriage include only knit/purl stitch patterns, but we see no reason why lace and other kinds of stitches cannot be incorporated into the knit/purl fabric if punched rows for the lace and/or K carriage are included on the punchcard. The adaptor rails for the 860/881 machine must be removed before the L or K carriages can be used. This is no problem. Just lift them off while the G carriage waits on the extension rail, use the appropriate carriage, then lay them down again. On the new 890 machine, for use with the KG 89, the rail is built in, and the various carriages can be used interchangeably.

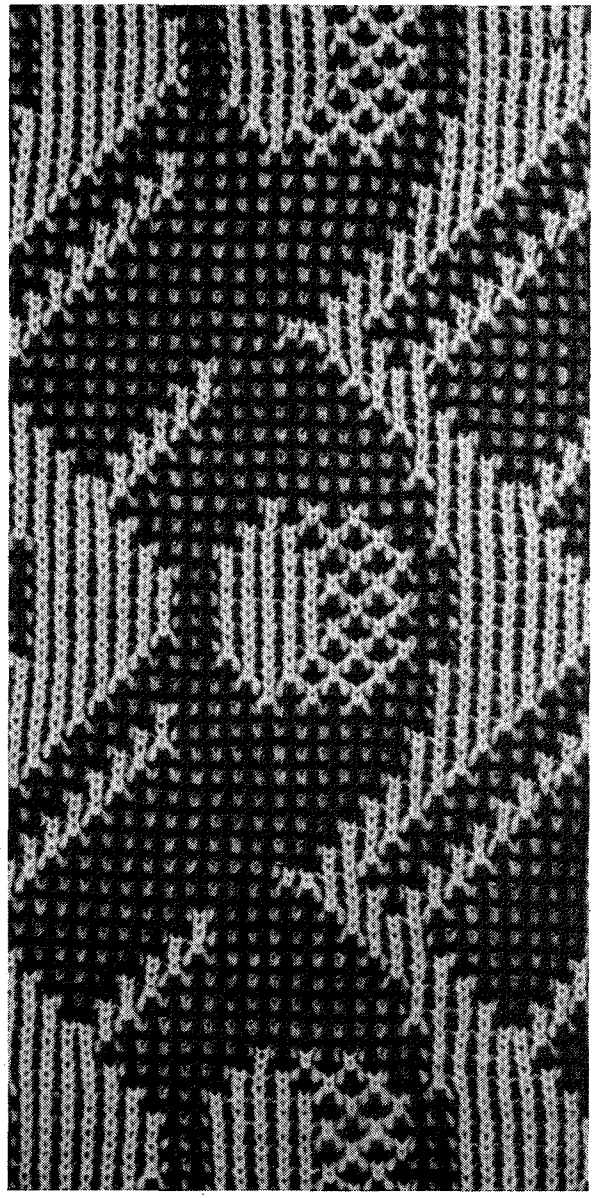


Top. A Jac 40 for Japanese machines.
Bottom. A Jac 40 for European machines, with the optional Alinea for Passap.



A collection of both fixed and adjustable pattern rulers from various machine manufacturers, and a homemade one for a four-row-repeat pattern.

CHAPTER 1
Jacquard Fabrics



Jacquard is one of the best known and most exciting kinds of machine knitting. Because it offers such enticing opportunity for experimentation with color and pattern, it can rapidly initiate the knitter into the art of creating original patterns and designs.

The principle underlying jacquard knitting came to machine knitting from traditional harness loom weaving. In 1805, in France, Joseph Marie Jacquard patented a loom attachment which incorporated a series of cards with holes punched in them. These cards mechanically selected warp threads for pattern weaving, which enormously speeded up the weaving of complex and intricate designs. Because his punched card principle has been applied to the selecting of needles for designing on knitting machines, the name Jacquard is as familiar to machine knitters as to weavers.

Theoretically, all punchcard knitting can be called jacquard, but to most machine knitters, the term implies a more or less flat fabric with a design having two to four (or more) colors per row. The design can be a "picture" or motif, an all-over pattern, or a combination of both. Today's electronic machines are the masters in their ability to separate, combine, lengthen, shorten, widen, narrow, and mirror jacquard patterns. Our concern here, however, is not with the design itself, but the fabric in which you choose to knit it.

Jacquard knitting in the instruction books is based on slip stitch, using one color for the background, the main color, and a contrast color for the design. The background stitches in each row are in the MC and the MC yarn slips behind the stitches saved for the design in that row; thus, if it is a jersey fabric, floats are formed. Meantime, the CC knits all the design stitches and slips behind the background stitches, forming more floats. The arrangement of the design and background stitches usually changes each pattern row, making a design in the knitting.

The best way to design a two-color jacquard pattern is to draw it on graph paper. Each square represents one stitch and either one or two knitted rows, depending on the pattern and the machine. The squares representing one color, usually that of the design, are filled in; those for the background color are left blank. In the simplest form of jacquard, the graphed design is transferred to a punchcard. The punched holes correspond to the filled squares and will cause the machine to knit one of the colors. The unpunched spaces correspond to the blank squares and will cause the machine to knit the other color. A full description of the types and designing of punchcards is found in Reference Chapter 4.

JERSEY JACQUARD

Jersey jacquard is also known as *fairisle, knit-in, slip-knit* and *skip-knit*. It is made single bed, by knitting and slipping the various colors in the manner described above. The face of the fabric is stockinette or jersey, with floats on the reverse. The method is described in all knitting machine instruction books, and is the same method hand knitters use. The most commonly used patterns are those which create short floats, such as the traditional Fair Isle and Shetland designs, and other patterns with small repeats or checked backgrounds. Patterns creating long floats make knitting difficult, are subject to snagging, and are usually more suitable for other types of jacquard knitting.

Jersey jacquard can be knitted by two methods on three of the machines in this book. Passap is the exception.

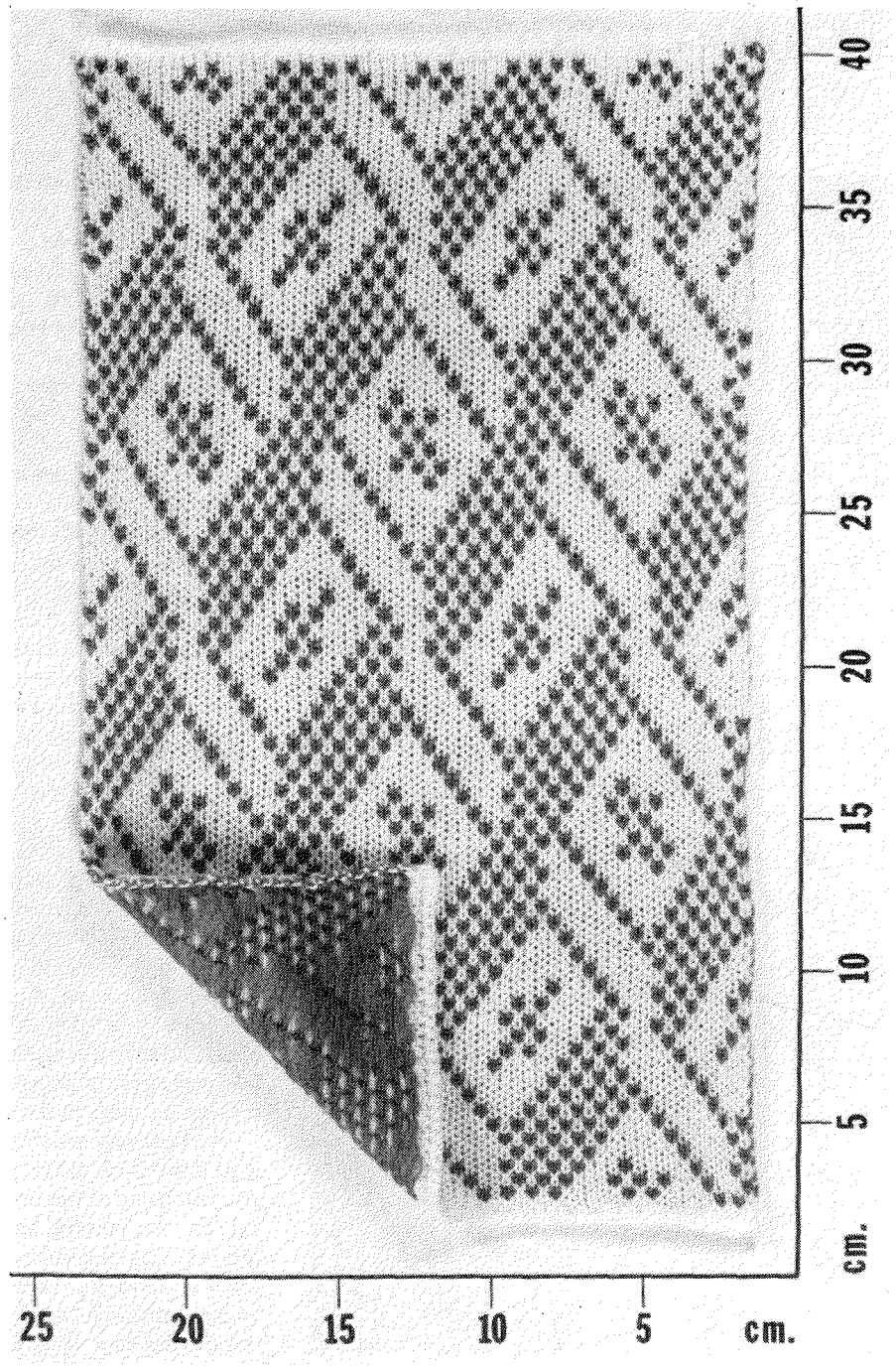
The Double feed method. This is a simple, quick and direct method of knitting a pattern with two colors per row, and is used on Superba, Brother/Knitking, and Singer/Studio. Both yarns are inserted into the feeder in separate slots. They knit simultaneously, one color knitting the needles selected for the design, and the other knitting the non-selected needles for the background.

The Type A-1 or A-2 punchcard (illustrated in Reference Chapter 4) is used for this method. In card Type A-1, holes are punched for the design only; the background is left unpunched (with card Type A-2, it is just the reverse). Needles are selected by the punched holes to move to HP and knit the contrast color yarn in the second slot; the unselected needles will move to patterning position and knit the main color yarn in the main slot in the feeder. There is always a special cam setting on the carriage which causes the needles to move in this manner for the double feed system. If you wish to select the needles

manually for a pattern, move the needles for the design only (CC) to patt pos., then knit the row. The special cam setting will cause all the needles to knit their respective yarns, the same as with a punchcard.

The Single Feed Method. Passap also uses the Type A-1 or A-2 punchcard for knitting two colors per row, but uses the single feed system, with each color knitting in turn (MC, then CC). The arrow key on the carriage is used to switch the pusher selection for the design and background in each color. To select the pushers manually, start with all the pushers in RP, then move the ones to knit the design into WP. The cam settings and color changes are the same as with a punchcard.

Two colors per row also can be knitted by the single feed method on the Japanese machines with punchcards Type B and C. It is useful for knitting patterns with long floats, by incorporating needles on the ribber, and for knitting tubular jacquard with cams set for slip. Each color is knitted in turn. The B and C cards are designed so that holes are punched for needles that knit in a row; unpunched spaces cause needles to slip. In two-color work, two punched rows are required for each pattern row. All the background stitches are punched on one row and are knitted with MC; all the design stitches are punched on the next row and knitted with CC. All machines use the single feed method to knit patterns with three and four colors per row. Punchcard Type D is used, and the cams set to slip. The same principle used in punching the B and C cards applies to designs with three and four colors per row; each color in a pattern row must have its own punched row. A four-color changer is very useful for this kind of knitting.



Jersey jacquard fabric with 2 colors per patt row and 2 knitted rows per patt row. Example of a pattern with short floats. Design: jacquard Pattern 2.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Double Feed **MC - main feeder** **CC - second feeder**		Type A ↑ ⊓ ∧ ↑ DYG	Type A MC	Type A Knit-in
Single Feed **RC2 each color**	2 col - Type A 3, 4 col - Type D GX BX ← Deco 4 (2 col) BXo Deco 2 (3, 4 col)	2 col. { Type A - Norwegian jacquard Type C1 - EOR 4 col - Type D - EOR o RC2 ea col claw	2 col. { Type B - ER Type C - EOR 4 col - Type D - EOR part ↔ RC2 ea col	2 col. { Type B - ER Type C - EOR 4 col - Type D - EOR △ slip △ RC2 ea col

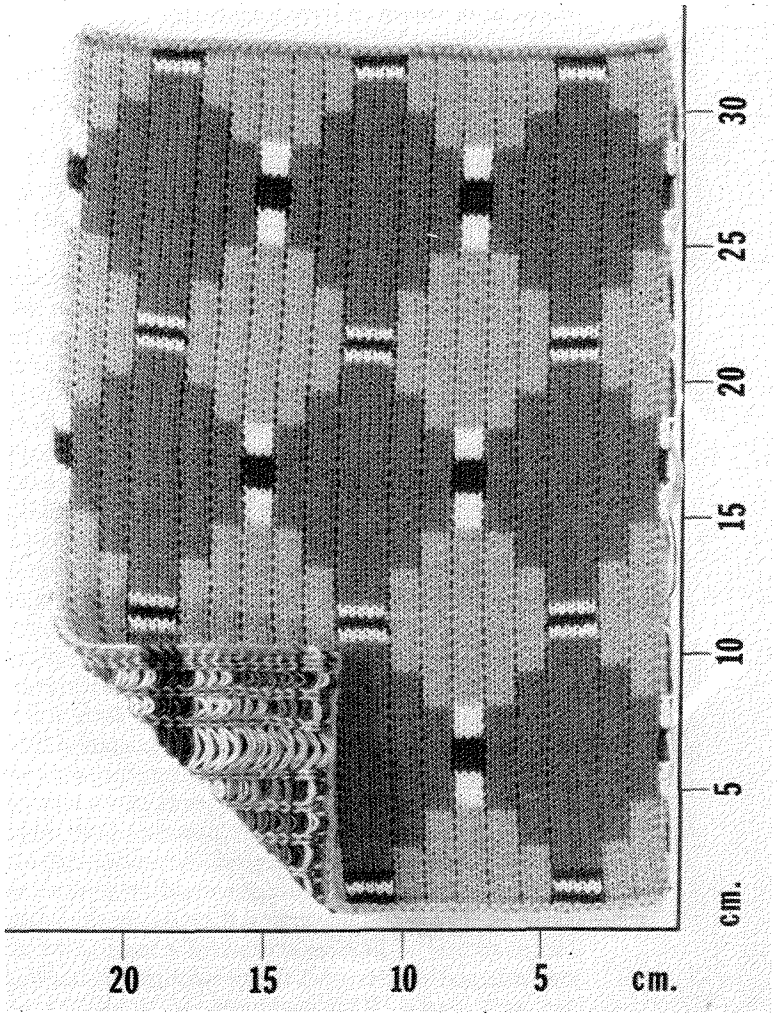
Managing floats in jersey jacquard.

Nearly every basic machine knitting book includes discussion about the reverse side of a jersey jacquard fabric; managing long floats, and joining the edges of a motif to its background fabric. When knitting an isolated motif the edges of the motif must be attached to the main fabric on each pattern row, either by using a separate yarn or by wrapping the adjacent background needles with the motif yarn.

Another important matter is long floats. There are several methods for dealing with them; the one you choose will depend mostly on the arrangement of the floats on the fabric reverse. A vertical series of floats can be latched up, either during or after knitting, with the last one hung on a central needle or tacked in place with sewing thread. Or they can be gathered in groups and tied up with another yarn after knitting. An isolated long float can be lifted onto a central needle, immediately after it has been knitted, to tie it into the fabric. The treatment of long floats can be decorative, making the reverse of the fabric as beautiful and interesting as the face.

Another method for dealing with long floats requires a second bed and, except on Superba, the fabric must be knitted by the single feed method. With a few strategically placed needles in WP on the second bed, long floats can be "tied" automatically to the fabric by allowing these rib needles to knit once or twice each pattern row. The carriage on the second bed can be set for either knit or tubular (slip one direction, knit the other direction); the stitch size should be as small as possible. There will be vertical divisions in the fabric face as a result of the rib stitches on the backing, which can enhance the design if the needles on the backing are well placed. This technique is similar to rib jacquard, and is very useful when knitting three or four colors per row, or when knitting with heavy yarns in two colors, when regular rib jacquard would make the fabric too thick.

The photo on the next page is an example of jersey jacquard with isolated rib stitches as a backing.



Jersey jacquard fabric with single ndls spaced on second bed, knitting EOR, to prevent long floats on fabric reverse. These sts cause the face sts to divide into ribs. Design: jacquard Pattern 7.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Jersey Jacquard with Rib	Type A single feed CX, N, or HX ← BX ← Deco 4	Type A ↑ ⊓ Λ ↑ Λ or ↻ can also add ⊓ on FB DYG	Type B - ER Type C - EOR single feed part ↔ N N or N part	Type B - ER Type C - EOR single feed △ slip △ 1 1 or 1 ← o

TUBULAR JERSEY JACQUARD

Tubular knitting, which requires a second needle bed, is not often seen using jersey jacquard or other patterning. Yet seamless knitting *can* be done with either jacquard or textured patterning, and should be considered for items like socks, mittens, gloves, scarves, legwarmers, and ski hats, and we would like to delve into the subject a bit here.

In tubular stockinette knitting, when the carriages are moved in one direction, one bed knits; when moved in the opposite direction, the other bed takes up the yarn and knits. Therefore the yarn is travelling in a circle: each bed knits every other row and the carriage always passes on it from the same direction to knit that row.

The single feed system must be used to knit tubular jersey jacquard, with the appropriate punchcard Type for each machine. Since a minimum of two passes of the carriage is required to knit one pattern row on the main bed (one pass for each color), there will be twice the number of rows on the second bed if all the needles knit with each pass of the carriage. A very unbalanced tube will result unless the second bed is also knitting a pattern.

The photographs show three practical ways to knit tubular slip and tuck stitch patterns. The designs are in two-color jacquard and tucked mosaic patterns, because these present the most challenging problems in matching gauges between the two beds, controlling punchcards, and handling the number of color rows for each pattern row. Of course, other types of single bed fabric designs can be used as well.

Compared to stockinette, a tuck stitch fabric with the same number of stitches and rows tends to be shorter and wider. A slip stitch fabric will be shorter and narrower. How much, in either case, depends on the number of rows and stitches being slipped or tucked. A two-color mosaic tuck pattern shortens about a third, a jacquard about half. The width changes are less extreme, but still must be considered, especially when plain stockinette is the fabric chosen for the second bed.

COMBINING STOCKINETTE WITH PATTERNING IN TUBULAR KNIT

All machines except Passap must use either stockinette or manual patterning on the second bed. The

following are suggestions for dealing with the differences in gauge which occur when stockinette is knitted on the second bed and tuck or slip on the main bed. First, it is wise to use a yarn with good compressibility, which will compact or expand to suit the need.

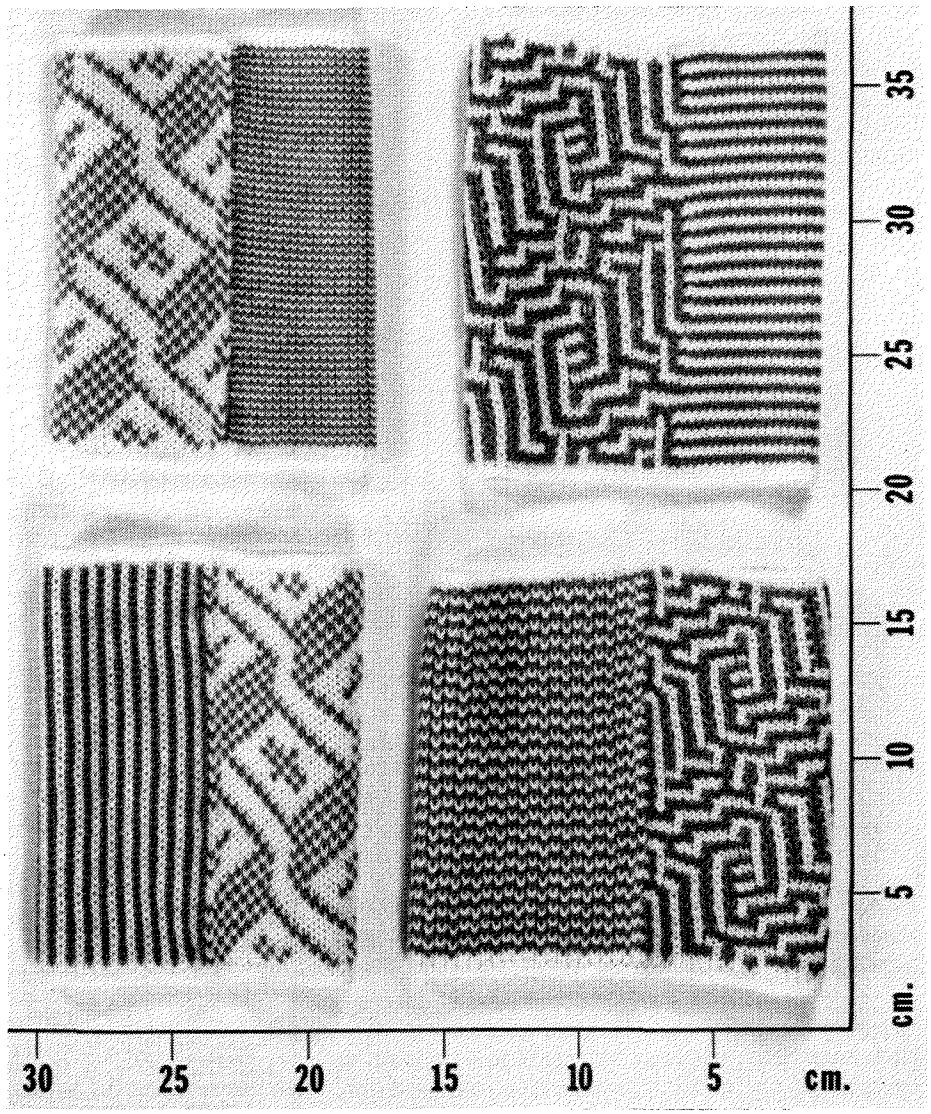
Control of the row gauge between the two beds. Use different stitch sizes on each bed. Assuming the gauge for the stitch size dial is the same on both beds, make the stitch size on the stockinette (second) bed as small as the yarn will take, and the slip or tuck stitch on the main bed as large as is appropriate for the pattern. The row gauge will even up quite nicely. The stockinette side will be very firm—ideal for palms of mittens or gloves, or the foot of a sock.

Control of the stitch gauge between the two beds. Use more or fewer needles on one bed than on the other. This technique is suitable only for small projects with narrow widths. Add or remove one needle at each end of one of the beds to equalize the width between the jacquard or tuck pattern and the stockinette. If the number of needles for the stockinette bed remains the same, then, for a slip stitch pattern, use two *more* needles, one added at each end, on the main bed. For tuck stitch, use two fewer needles, one removed from each end, on the main bed. Adding or removing more than two needles will result in floats between the two beds.

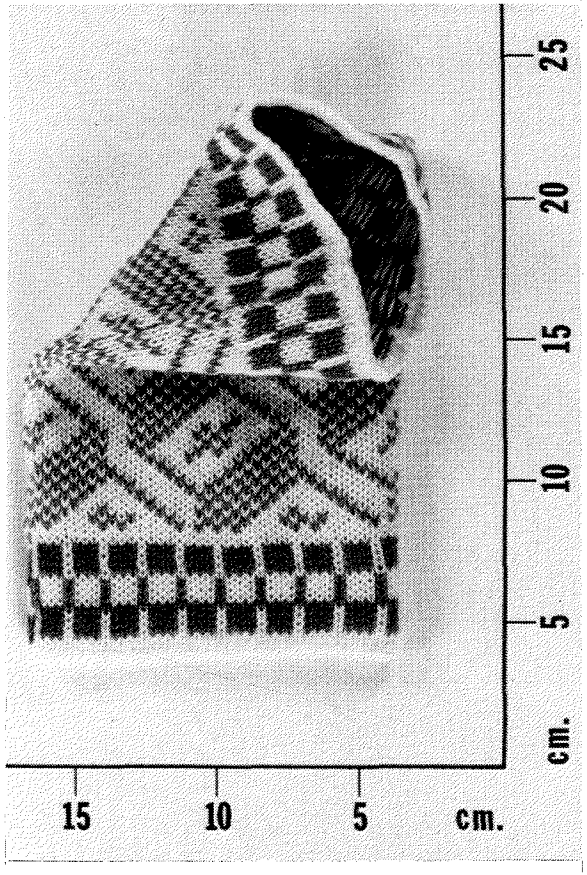
Block carefully. A small difference between the two sides of the fabric can be blocked out, particularly if you use yarns with good recovery.

Take advantage of the characteristics of your stitch combinations. For example, a wider tuck stitch coupled with the narrower stockinette will, when blocked flat, result in a border of tuck stitches on each side of the stockinette. This can be a nice touch on the lining side of a scarf.

If there is a great difference between the number of needles on each bed, there will be floats between the two sides of the fabric. These can be an integral part of the design if latched up with another color yarn, or, if they are long enough, by latching them up in groups. Or, plan for very long floats, cut them to make fringes, and knot them at their bases, thus joining the two sides of the fabric.



Tubular jacquard and tucked mosaic patterns. Design: jacquard Pattern 2.
Top left: jacquard knitted on MB, stockinette with very small SS on second bed. Stockinette stripes are 1 row each color.
Top right: tuck mosaic knitted on MB, stockinette with very small SS on second bed. Stockinette stripes are 2 rows each color.
Bottom left: jacquard knitted on MB, 1x1 slip/knit on second bed. Identical SS on both beds.
Bottom right: tuck mosaic knitted on MB, 1x1 tuck/knit on second bed. Identical SS on both beds.



Tubular jacquard with identical pattern on both beds. Made with a Jac 40 and punchcard, both beds. Design: jacquard Pattern 2.

	Passap carr R	**Superba** carr R	**Brother/Knitking** carr L	**Singer/Studio** carr L
Tubular Stockinette no patterning	CX / CX	C / ↻	part ← / N part	o slip △ / 1 ↙ o
Tubular/Slip Stockinette MB - Jacquard 2nd bed-Stockinette 1 knit row per pattern row	Type A CX / HX ← Deco 4 RC2 ea col	Type C1 - EOR o / ↻ No R cursor stop. Cursor at carr R only. RC2 ea col See also Superba Specials. claw	Type C1 - EOR Type C2 - ER part ↔ / N part RC2 ea col Push back to B pos selected ndls EOR	Type C1 - EOR Type C2 - ER o slip △ / 1 ↙ o RC2 ea col
Tubular Tuck/ Stockinette MB - Mosaic 2nd bed-Stockinette 2 knit rows per pattern row	Type A1 RC2 CX / DX ← ; RC2 CX / DXo Deco 4 RC4 ea col	Type A1 stop card neg rev RC1 ⌒ / ↻ ; RC1 o / ↻ No R cursor stop. Cursor at carr R only. RC4 ea col Advance card to next patt row. claw	Type A2 - ER ← part/tuck → / N part RC4 ea col. Stop card before knitting row 1 ea col. Start card before knitting row 4 ea col. Push back selected ndls MB EOR	Type A2 - ER RC1 o tuck △ / 1 ↙ o ; RC1 o slip △ / 1 ↙ o RC4 ea col. Stop card before knitting row 1 ea col. Start card before knitting row 4 ea col
Tubular Slip/1x1 Slip MB - Jacquard 2nd bed-1x1 Slip/Knit 1 knit row per pattern row	Type A HX ← push. 1x1 WP/RP / HX ← Deco 4 RC2 ea col	Type A o / o No R cursor stop. Cursor at carr R only. RC2 ea col. On FB, select odd ndls col 1, even ndls col 2. claw	Type C1 - EOR TypeC2 - ER part ↔ / part ↔ RC2 ea col. Select odd ndls ribber col 1; even ndls col 2. Push back selected ndls MB EOR	Type C1 - EOR Type C2 - ER o slip △ / o ↙ o RC2 ea col. Select odd ndls. ribber col 1; even ndls col 2
Tubular Tuck/ 1x1 Tuck MB - Mosaic 2nd bed-1x1Tuck/Knit 2 knit rows per pattern row	Type A1 RC4 ea col RC2 DX ← / DX ← ; RC2 DX ← / DXo push 1x1 WP/RP / Deco 4	Type A1 neg rev stop card RC1 ⌒ / o ; RC1 o / o No R cursor stop. Cursor at carr R only. RC4 ea col. Select odd ndls, then even ndls FB EOR. Advance card to next patt row. claw	Type A2 - ER ← part/tuck → / tuck ↔ RC4 ea col. Select odd ndls, then even ndls on ribber EOR. Push back selected ndls MB EOR.	Type A2 - ER RC1 o tuck △ / o ∩ o ; RC1 o slip △ / o ∩ o RC4 ea col. Select odd ndls, then even ndls on ribber EOR.
Tubular Jersey Jacquard Jersey Jacquard both beds 1 knit row per pattern row	Type A HX ← Jac 40 / HX ← Deco 4 RC2 ea col. Insert Jac card right side up. Pushers RP, select to WP every RC4.	Type C1 - EOR Type C1 - Jac o / o No R cursor stop. Cursor at carr R only. RC2 ea col. On FB, select ndls with Jac to pos 2, EOR. claw	Type C1 - EOR Type C2 - ER Type C1 - Jac part ↔ / part ↔ RC2 ea col. On ribber, select ndls with Jac to D pos EOR. On MB, push back selected ndls EOR.	Type C1 - EOR Type C2 - ER Type C1 - Jac o slip △ / o ↙ o RC2 ea col. On ribber, select ndls with Jac to C pos EOR.

TECHNIQUES FOR TUBULAR PATTERNING

The swatches illustrated were knitted two repeats wide and two repeats high. Both the jacquard and the mosaic patterns use the same punchcard design, jacquard Pattern 2.

1. With an even number of needles in WP, the beds usually should be set at full pitch; for an odd number, at half pitch. This keeps the sinker loop passing between the beds the correct length and prevents a visible mark up the sides of the knitting. Sometimes, however, the reverse is better. It depends on yarn thickness and stitch size.

2. If the second bed is knitting stockinette, it will be easier to knit small stitches if extra weights are added.

3. The second bed may also knit a pattern, which will eliminate the concern of matching the gauges of the two sides of the fabric. Illustrated are 1x1 selections on the second bed, alternating for each color. On Passap, pushers can be set up 1x1 WP/RP. On other machines it will be necessary to select alternating groups manually with a pattern ruler, each row. The lili buttons on Brother/Knitking and Superba cannot be used for these fabrics. Cams and stitch size are the same on both beds, to keep the gauge the same on both beds. Of course, it is also possible to exaggerate a gauge difference in fabrics on the two beds, by knitting, for example, a tuck pattern on one bed and a slip on the other.

4. To make a tubular fabric with the same patterning all around, as for sock legs and ski hats, a punchcard in the reader may be coupled with an identical card in the Jac 40 for the second bed. A simple pattern can be knitted manually with a pattern ruler on both beds.

5. When knitting a jacquard or other slip stitch pattern coupled with selection on the second bed, be sure to hook each color yarn around the last needle opposite the color changer (if it is not knitting that needle) to ensure that both yarns are carried completely to the selvedge.

6. Mosaic patterns must be knitted with two rows of the same color, with the same needle selection (RC4 each color), to keep the horizontal parts of the design in proportion to the verticals. Jacquard patterns can be knitted with either one or two rows of the same color with the same needle selection (RC2 or 4 each color).

7. A special version of a tubular jacquard/stockinette combination can be made on Superba. The MB knits jacquard while the second bed plates the two yarns in stockinette. Stitch size is about the same for both beds. A sample swatch and cam settings are shown in the Superba Specials section of this chapter.

RIB JACQUARDS

Rib jacquards, also known as *double jacquard, fairisle, double fairisle and multicolored rib,* are made double bed. A backing is knitted on the second bed simultaneously with the design on the main bed. Floats on the reverse of jersey jacquards are knitted into the backing, producing a thicker, more stable, often reversible fabric.

For two colors per row, Type B and C cards are used on Japanese machines, and Type A cards on the European machines. Type D cards are used on all machines to knit 3 and 4 colors per row. The design itself can be knitted using the same technique and the same cam settings as for *single feed* jersey jacquard.

On the Superba only, rib jacquards can also be knitted with the double feed system to produce special fabrics. These will be discussed separately.

The design possibilities for rib jacquard fabrics are virtually limitless. Large designs, which would result in excessively long floats in jersey jacquard, can be knitted without concern. The interaction of stitches between the face and backing of the fabric can be varied in several ways to produce flat, ribbed, or relief textures. The techniques explained in this chapter are for flat and ribbed fabrics; relief fabrics are discussed elsewhere in the book. We hope the techniques introduced here will inspire you to design your own rib jacquard fabrics.

CHARACTERISTICS OF RIB JACQUARD FABRICS

1. Some techniques will cause a lengthwise and/or widthwise expansion of the design, while others will contract it.

2. Using a slip stitch cam setting on one or both beds produces a tighter fabric. Tucking on one or both beds produces a very stretchy fabric. Tucking on one bed while slipping on the other, or tucking and slipping on alternate rows, yields a fabric with properties of both slip and tuck.

3. The surface texture of both face and backing will vary with each technique, as it is a direct result of the interaction between the stitches of the two surfaces. If the number of colors per row is changed, the texture may also change, even with the same cam setting.

4. Some techniques produce a balanced fabric and others an unbalanced one, where a difference exists in the number of rows between the face and backing in each pattern row. This balance influences the thickness and stability of the fabric, which will be modified with each color added. Your choice of technique depends mainly on the number of colors per row, type of yarn, and degree of expansion or contraction you want in your design.

5. With any technique, using two colors per pattern row produces a lighter weight fabric than will three or four colors per pattern row, because each color added means extra yarn must be accommodated in the backing.

6. "Grin-through" is more apparent when three or four colors are used in each pattern row than with two colors. Some techniques produce more grin-through than others, so you have to consider whether it enhances or detracts from your design.

7. Many techniques will produce a more or less reversible fabric. Some fabrics will have the same design on both sides but in reverse colors; on many the design will be "shadowed" on the reverse. Other fabrics will have stripes, checks or a solid color on the reverse. In general, patterns with two colors per row produce reversible fabrics better than patterns with three or four colors per row.

8. Since the same needle selection must take place on both beds simultaneously, some reversible jacquard fabrics will need two identical cards and a Jac 40 on the second bed. Of course, the Jac 40 or pattern ruler can be used on both beds simultaneously instead.

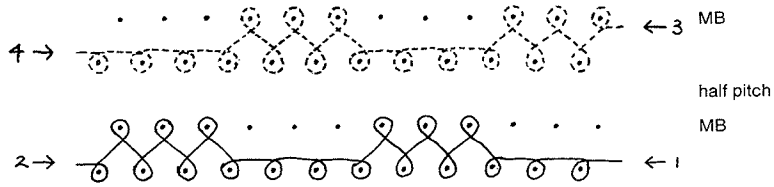
9. In garments using rib jacquard patterns, shaping is best accomplished by increasing and decreasing stitches, since putting needles in holding position for shaping can cause knitting problems in some fabrics on some machines. Or, so that you can focus all your attention on the fabric itself, consider cut-and-sew construction, especially for necklines and other places requiring careful shaping.

TWO-COLOR RIB JACQUARD FABRICS

All the swatches shown were knitted with the same yarn and have the same number of repeats—three wide and three in length. All the designs have the same size repeats. The scale beside each swatch shows the differences in swatch sizes produced by each technique. Some of these techniques are adapted to three and four colors and are presented at the end of the chapter.

Beds are set at half pitch throughout, except for knitting eight-lock fabrics. Adding one extra needle on the second bed (to break the needle rule) ensures a good selvedge for all the swatches.

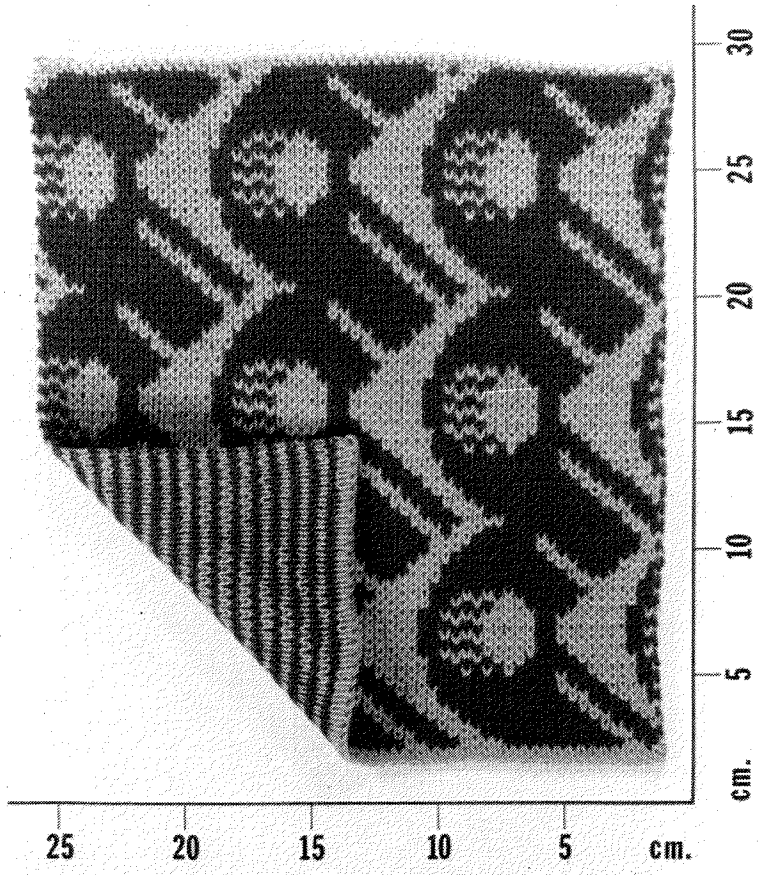
	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Striper Backing **1 row pattern = 2 rows backing** **or** **2 rows pattern = 4 rows backing**	Type A N / BX ← Deco 4 RC2 ea col	Type A - Norwegian jacquard Type C1 - EOR o / ^ RC2 ea col claw	Type B - ER Type C1 - EOR Type C2 - ER part ↔ / N N RC2 ea col	Type B - ER Type C1 - EOR Type C2 - ER △ slip △ / 1 1 RC2 ea col



Striper backing.

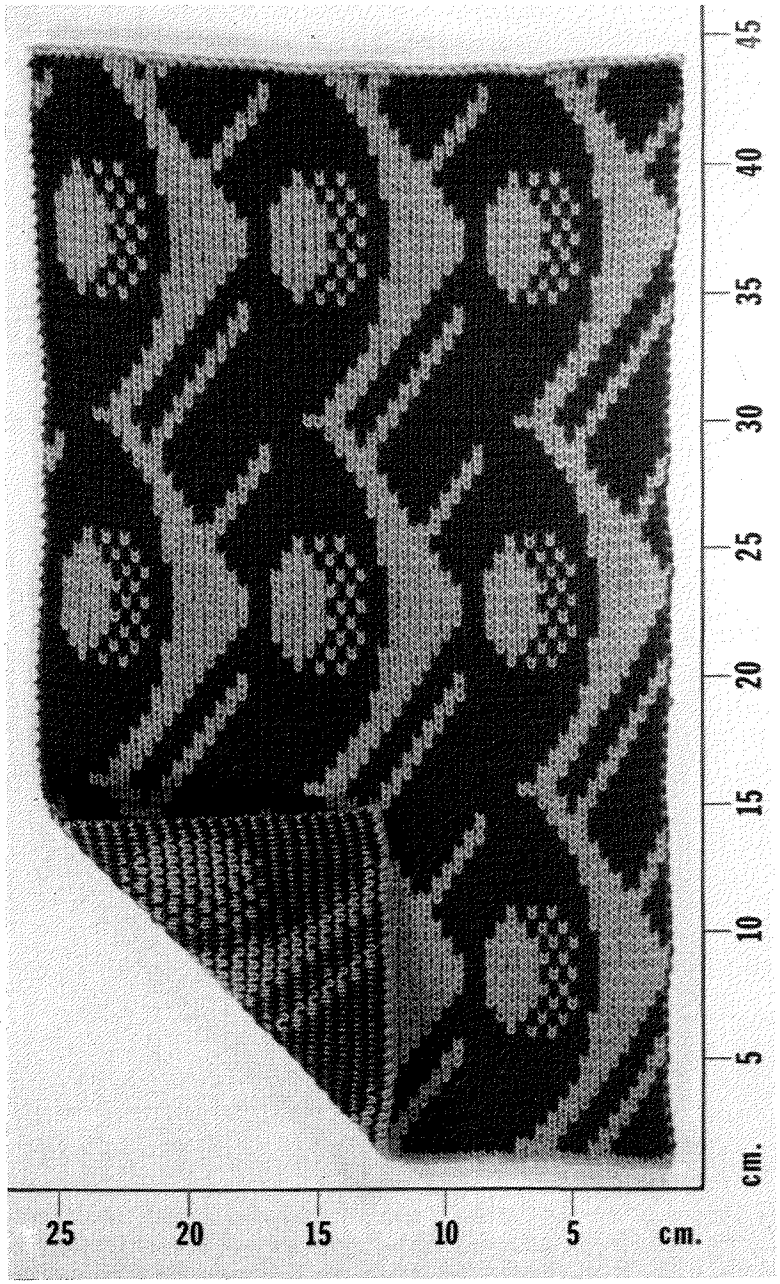
THE BASIC RIB JACQUARD FABRICS

The most common and most versatile way to knit rib jacquard patterns is to use slip stitch on the main bed, and either slip/knit or plain knitting on the second bed. We shall begin with these two basic methods of knitting the backing, both of which are usually described in the instruction books for the machines or color changers. We use the names given these backings by the knitting industry. One is *striper backing,* which knits horizontal stripes on the backing and requires no needle selection on the second bed. The other is *bird's-eye backing,* which requires a 1x1 needle selection on the second bed and produces an all-over, tiny one-needle check. Except for a few of the reversible fabrics, all the backing variations we'll discuss are based on these two basic methods. They can be modified in several ways and can produce all sorts of interesting fabrics when combined with variations in knitting on the main bed.

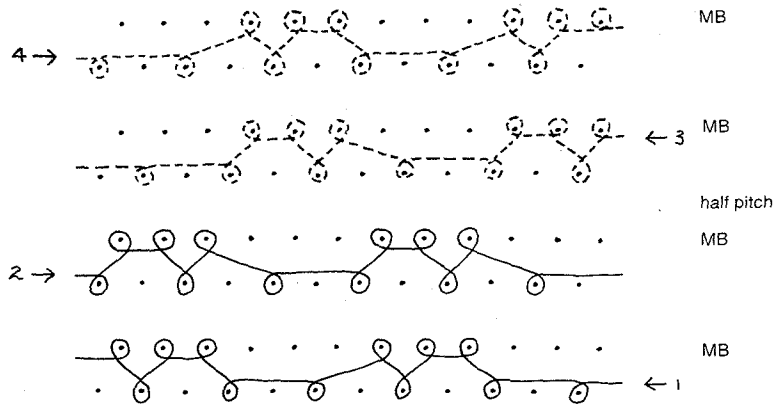


Striper backing. Design: jacquard Pattern 4. MB: knit/slip. Second bed: knit. All backing needles knit every row. The backing will appear as horizontal stripes, 2 rows each color. Stripes are even, as in the swatch above, when a Type B card is used. With Type A or C card, the design will be shadowed in the stripes (swatch at right). Stitches on the fabric face will be in perfect vertical alignment, which is characteristic of all jacquard fabrics with plain knitted backings. Fabric balance: 1 patt row = 2 backing rows; or 2 patt rows with same selection = 4 backing rows.

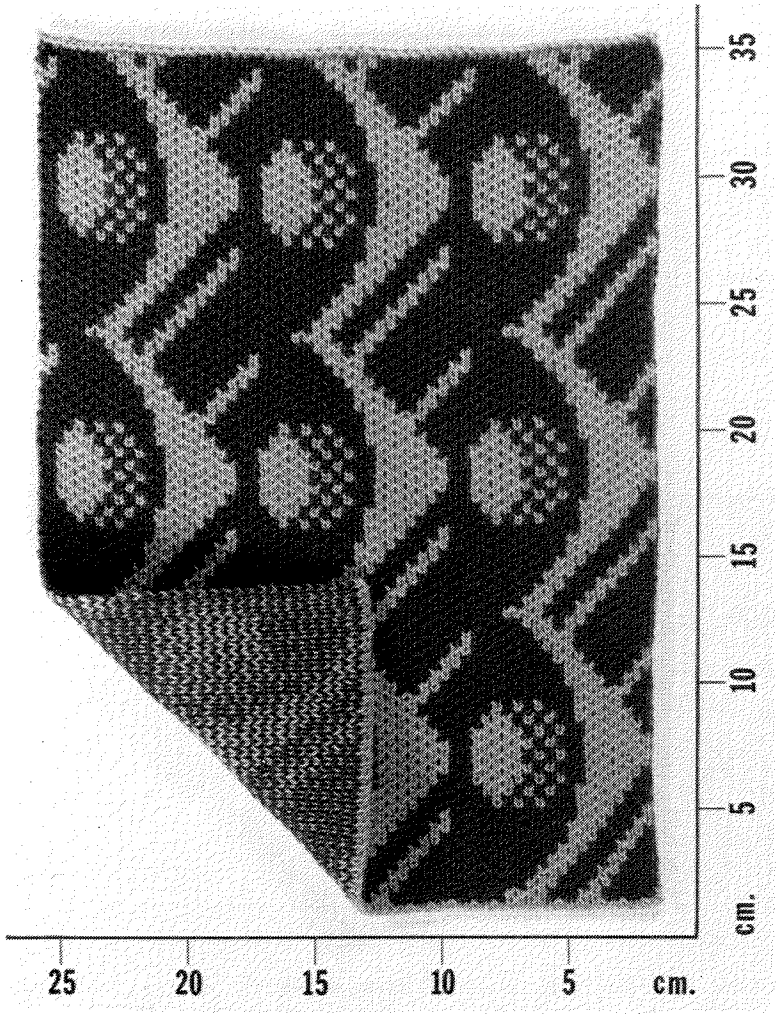
Variations (not shown). Striper can be varied by using punchcard Type B set to rotate EOR and knitting 4 rows each color. Backing stripes will be 4 rows each color, with each patt row knitted 2 rows alike.



	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Bird's-eye Backing **2 rows pattern = 2 rows backing**	Type A BX ↔ push 1x1 WP/RP BX ← Deco 4 RC2 ea col	Type A - Norwegian jacquard Type C1 - EOR o lili o lili even # ndls FB RC2 ea col claw	Type B - ER Type C1 - EOR Type C2 - ER part ↔ lili part ↔ lili even # ndls ribber RC2 ea col	Type B - ER Type C1 - EOR Type C2 - ER △ slip △ o ← o RC2 ea col. Select odd ndls, then even ndls on ribber, ER.
Bird's-eye Backing Var; Vertical Stripe **2 rows pattern = 2 rows backing**	Type A BX ← push 1x1 WP/RP BX ← Deco 4 RC2 ea col	Type A - Norwegian jacquard Type C1 - EOR o o RC2 ea col. On FB, select odd ndls col 1; even ndls col 2. claw	Type B - ER Type C1 - EOR Type C2 - ER part ↔ part ↔ RC2 ea col. On ribber, select odd ndls col 1; even ndls col 2.	Type B - ER Type C1 - EOR Type C2 - ER △ slip △ o ← o RC2 ea col. On ribber, select odd ndls col 1; even ndls col 2.



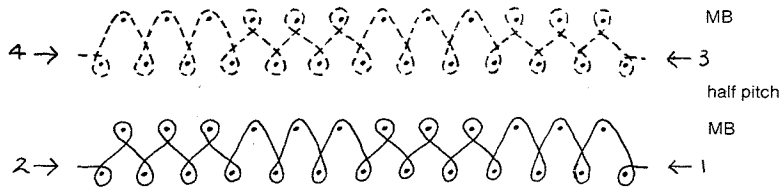
Bird's-eye backing.



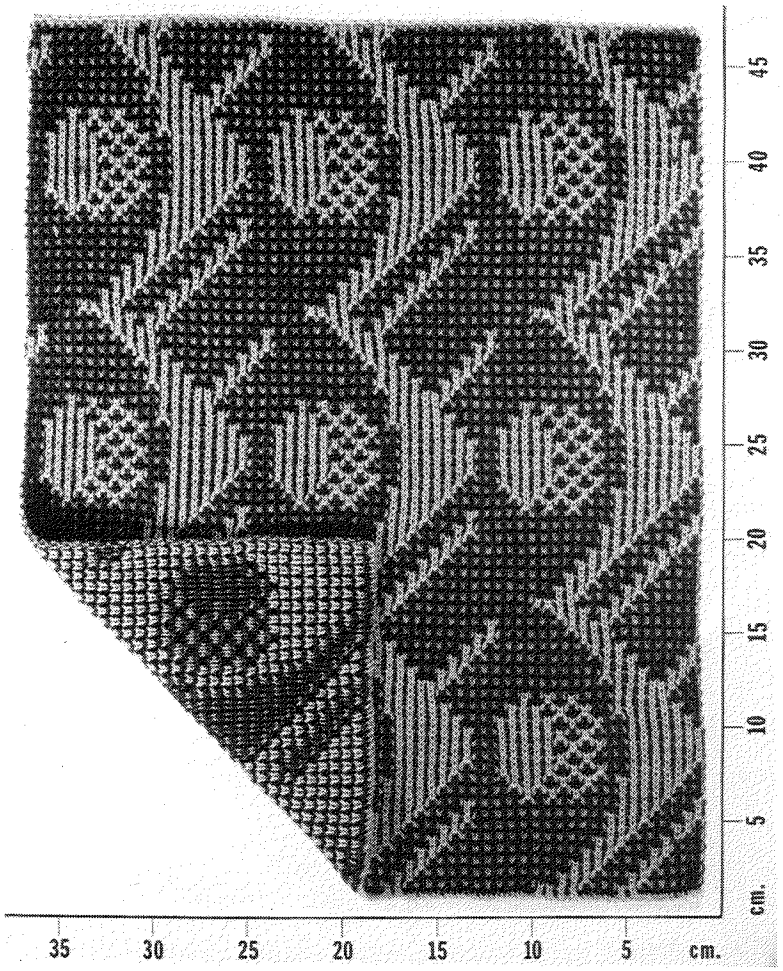
Bird's-eye backing. Design: jacquard Pattern 4. MB: knit/slip; second bed: knit/slip 1x1. Backing needles alternate knit/slip every row, to create a tiny checked appearance, or more typically, a scrambled appearance. Alternating needle selection on the backing causes stitches on the face to pull in an alternating diagonal direction creating the "bird's-eye" texture. A texture on the face created by diagonal pull of stitches is characteristic of all jacquard fabrics with needle selection on the backing. Fabric balance: 1 patt row = 1 backing row or 2 patt rows with same selection = 2 backing rows.

Variations. Design: jacquard Pattern 4. Bird's-eye can be varied by alternating the 1x1 backing selection EOR instead of ER to create vertical stripes, as in this swatch. It can also be knitted with 2x2 needle selection, alternating the selection every 4 rows to create a checked pattern. Note that the EOR selection causes the face to divide into ribs.

	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Basic Tuck Jacquard **2 rows pattern = 4 rows backing**	Type A N / AX ← Deco 4	Type A - Norwegian jacquard Type C1 - EOR ⌒ / ∧ RC2 ea col claw	Type B - ER Type C1 - EOR Type C2 - EOR tuck ↔ / N N RC2 ea col	Type B - ER Type C1 - EOR Type C2 - EOR △ tuck △ / 1 1 RC2 ea col
Basic Tuck Jacquard **Var: Fisherman's Rib** **2 rows pattern = 2 rows backing**	Type A AX ← WP or RP / AX ← Deco 4	Type C1 - EOR RC2 col 1 ⌒ / ⌒ ; RC2 col 2 ⌒ / ∧	Type C1 - EOR Type C2 - ER RC2 col 1 tuck ↔ / tuck ↔ ; RC2 col 2 tuck ↔ / N tuck N	Type C1 - EOR Type C2 - ER RC2 col 1 △ tuck △ / o ∩ o ; RC2 col 2 △ tuck △ / 1 ∩ 1

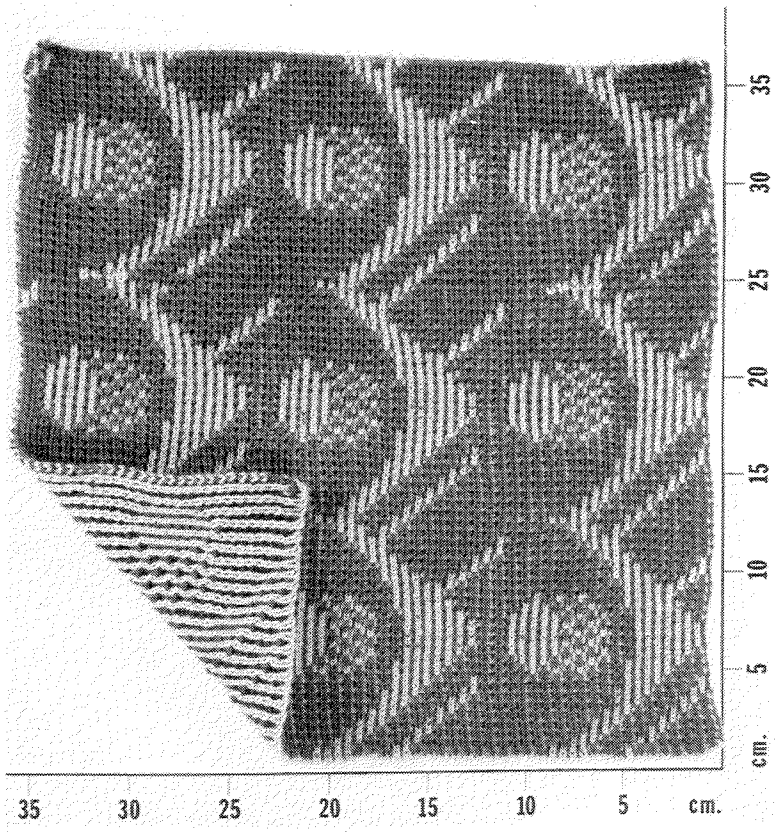


Basic tuck jacquard. Extra needle on backing bed.



Basic tuck jacquard. Design: jacquard Pattern 4. MB: knit/tuck. Second bed: knit. The fabric is knitted like basic striper backing, except the MB cam is set for tuck instead of slip. The backing will be nopped, with the nopps varying in size, depending on the design. The stitches on the face separate into vertical ribs, with each stitch outlined by the other color (grin-through). This is characteristic of all jacquard fabrics with tucking on the main bed. Note that the face stitches are in perfect vertical alignment, with no diagonal pull, because the backing is knitted plain. This fabric should be knitted with 2 knit rows per patt row, as there will be vertical condensing of the pattern. Fabric balance: 2 patt rows knitted with same selection = 4 backing rows.

Variations (not shown). Design: jacquard Pattern 4. Tucked jacquard can be made with smaller, smooth nopps on the backing by alternating a plain knitted row with a plain tucked row on the backing.

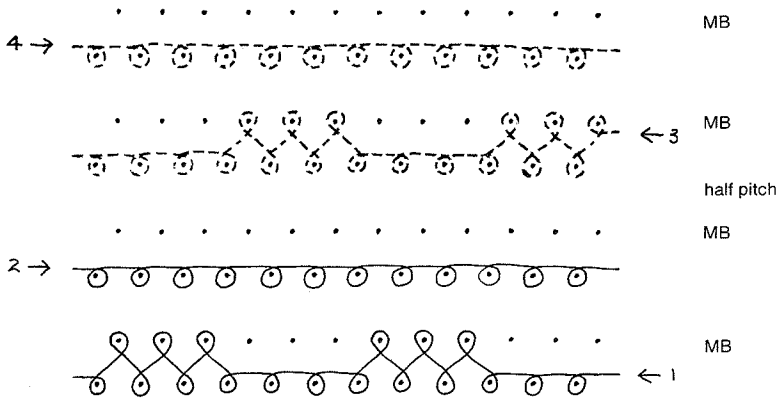


In the swatch above, if 2 plain knitted rows in col 1 are alternated with 2 plain tucked rows in col 2 on the backing, the design will knit in fisherman's rib while the background will be a flattened tuck rib. The backing will be solid, in col 1.

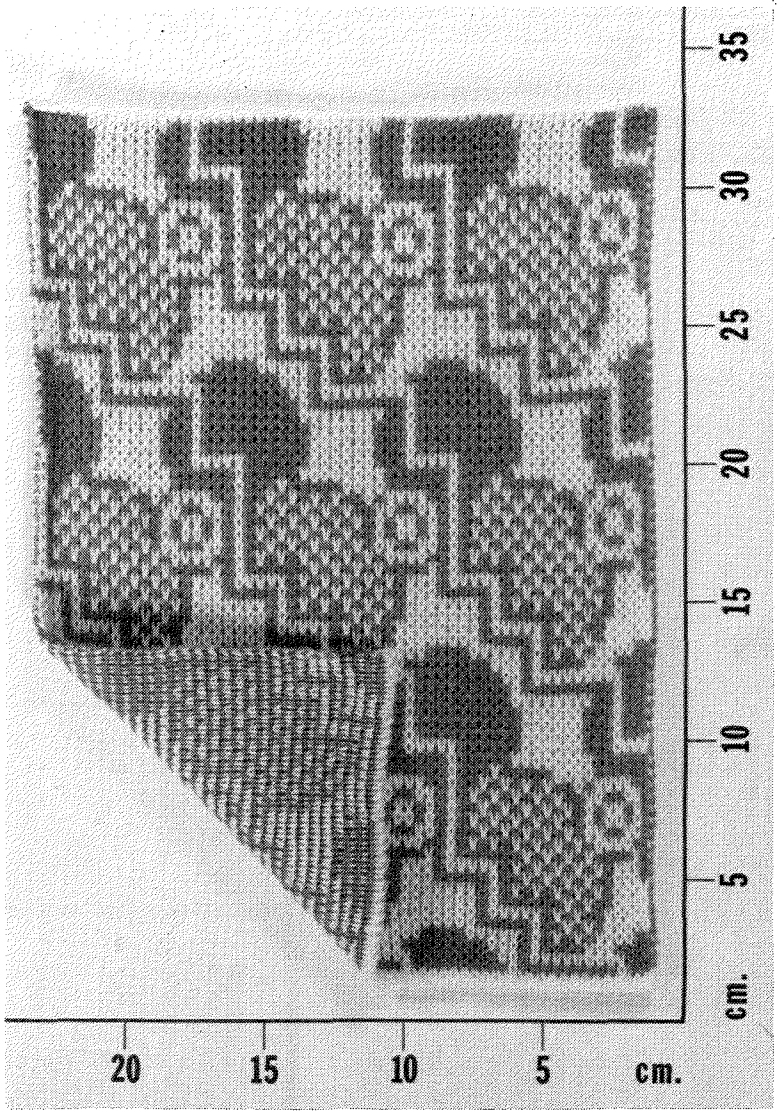
FABRICS WITH EXTRA BACKING ROWS

To add body to a fabric made with fine yarn, an extra row can be knitted every other row with each color on the second bed only. Both design and backing are knitted for the first row with color 1, then the second bed knits alone for the second row with color 1. These two rows are then repeated for the second color. Each pattern row on the face will be only one knitted row. When done in one color, this technique is known as *Long Stitch,* because the stitches on the fabric face are stretched lengthwise. It is often used for embossed designs.

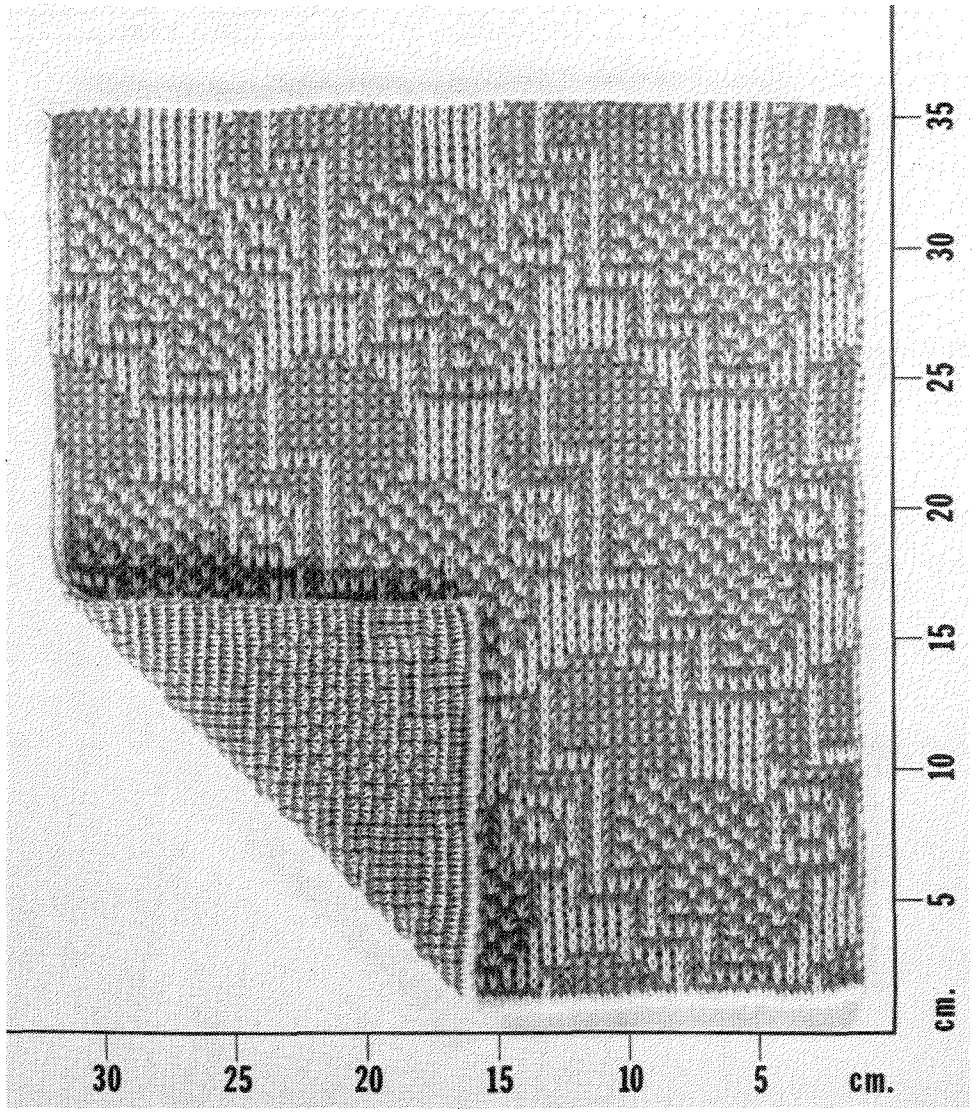
	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Half Milano **1 row pattern = 4 rows backing**	Type A N / HX ← Deco 4 RC2 ea col	Type C1 - EOR o / ^ No R cursor stop. Cursor at carr R only. RC2 ea col See also Superba Specials claw	Type C1 - EOR Type C2 - ER part ↔ / N N RC2 ea col. Push selected ndls to B pos MB EOR, or make a card as C with a blank row between each punched row.	Type C1 - EOR Type C2 - ER o slip △ / 1 1 RC2 ea col
Half Milano **Var: Tucked** **1 row pattern = 4 rows backing**	Type A N / DX ← Deco 4 RC2 ea col	Type C1 - EOR RC1 ⌒ ; RC1 o / ^ ^ No R cursor stop. Cursor at carr R only. RC2 ea col. claw	Type C1 - EOR Type C2 - ER ← part/tuck → / N N RC2 ea col. Follow instruction for Half Milano.	Type C1 - EOR Type C2 - ER o tuck △ / 1 1 RC2 ea col



Half Milano.

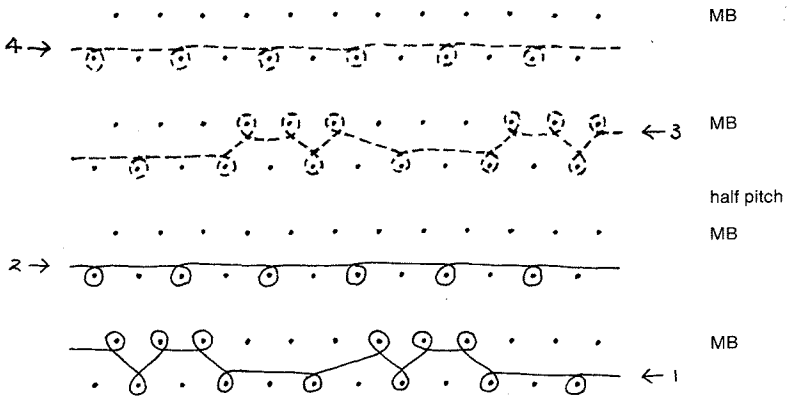


Half Milano. Design: jacquard Pattern 11. MB: knit/slip 1 row, slip all stitches 1 row. Second bed: knit all rows. The backing resembles striper backing, with 2 horizontal rows in each color, but its stitches will vary in size, causing the design in the face to be shadowed on the backing, as shown. Fabric balance: 1 patt row = 4 backing rows.

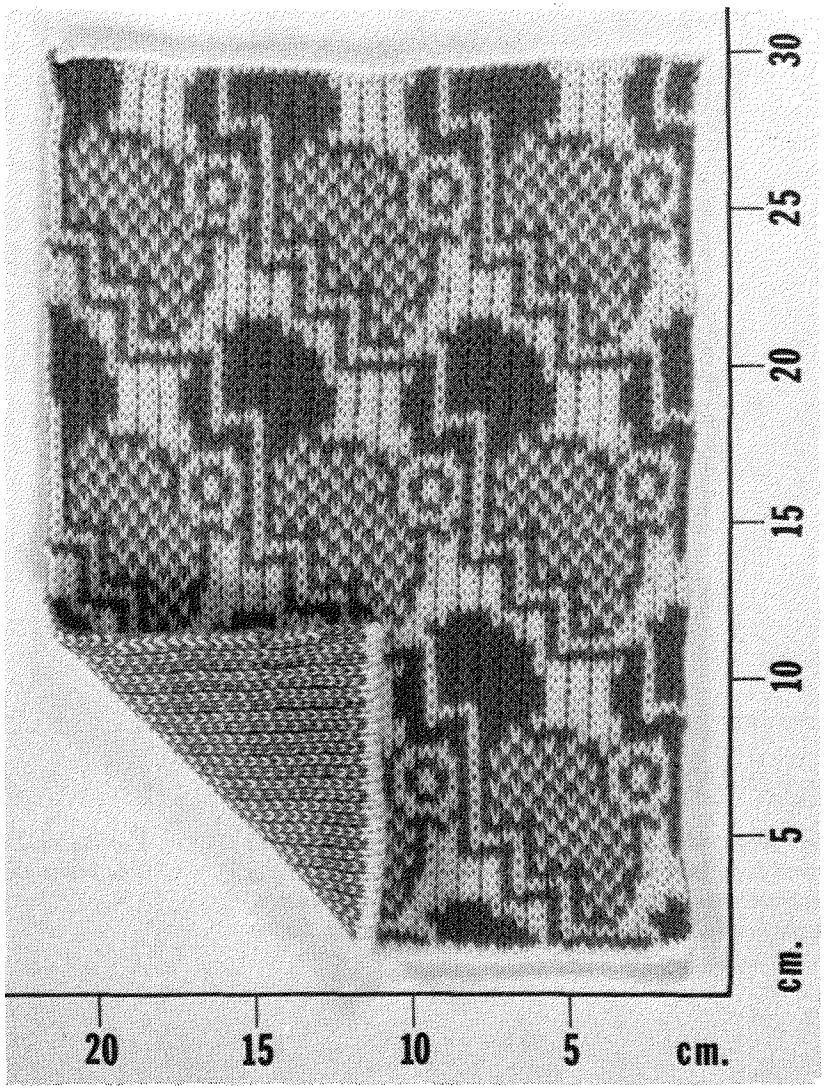


Variations. Design: jacquard Pattern 11. Half Milano can be knitted as knit/tuck on the MB. The fabric will be similar to basic tuck, but firmer.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Half Pique **1 row pattern =** **2 rows backing**	Type A BX ↔ push 1x1 WP/RP HX ← Deco 4 *RC2 ea col*	Type C1 - EOR o iii o iii Even # ndls FB. No R cursor stop. Cursor at carr R only. RC2 ea col. claw	Type C1 - EOR Type C2 - ER part ↔ iii part ↔ iii RC2 ea col. Follow instructions for Half Milano. Even # ndls ribber.	Type C1 - EOR Type C2 - ER o slip △ o ← o RC2 ea col. On ribber, select odd ndls, then even ndls ER.



Half pique.



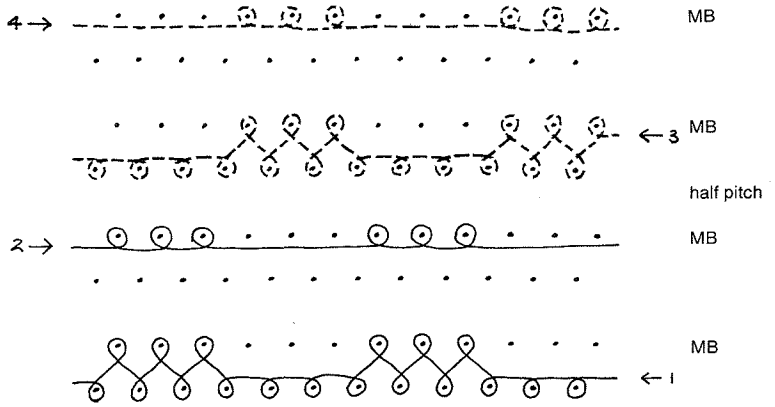
Half pique. Design: jacquard pattern 11. MB: knit/slip 1 row, slip all stitches 1 row. Second bed: knit/slip 1x1 all rows. Backing resembles bird's-eye but is closer to a tiny, perfect check. Face is divided into ribs, each 2 sts wide. Fabric balance: 1 patt row = 2 backing rows.

Variations: half pique. Design: jacquard Pattern 11. Vertical stripes will occur on the backing if 1x1 selection is alternated EOR instead of ER.

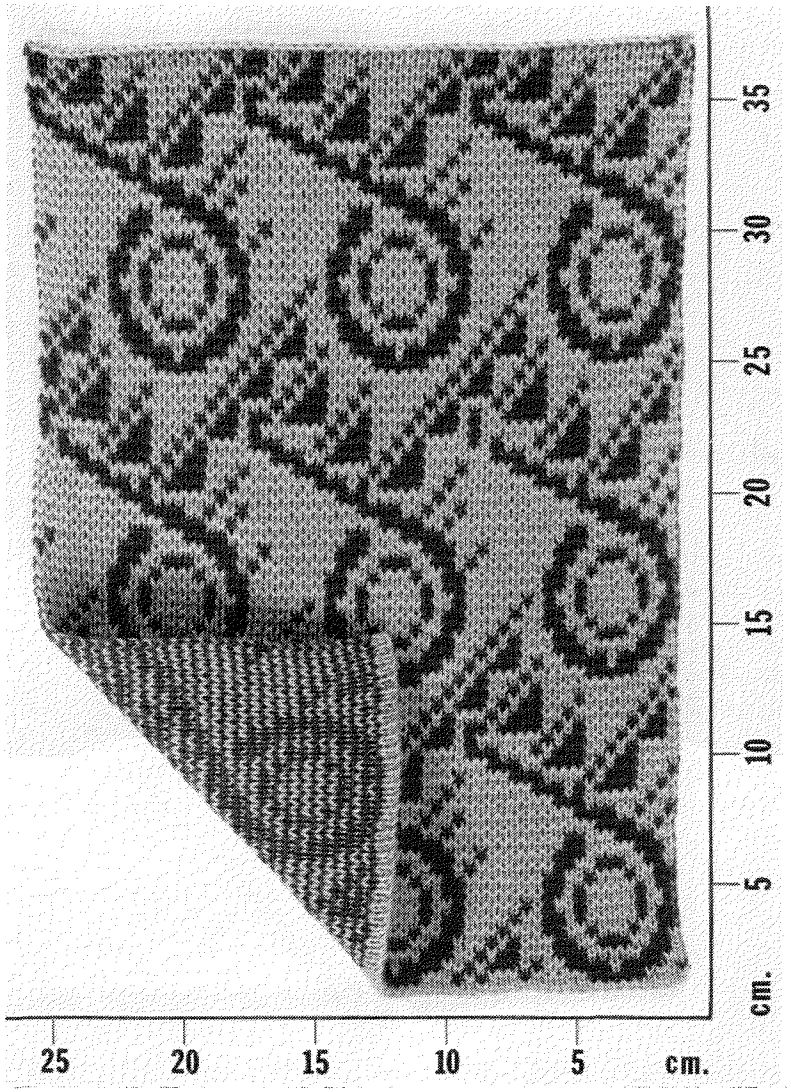
FABRICS WITH EXTRA PATTERN ROWS

Here we have the reverse of the above technique. One backing row is left out of the knitting every other row. This technique reduces the bulk created when heavier yarns are used for rib jacquard knitting. The fabric falls into the "weft knit" category, but is not a true weft knit fabric, since only *alternate* pattern rows have floats. In a true weft knit all the pattern rows have floats enclosed within the rib created by the backing. Because of the enclosed floats, weft knit fabrics have comparatively less stretch across the width.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Modified Weft Striper Backing **2 rows pattern = 2 rows backing**	Type A CX / BX ← Deco 4 RC2 ea col	Type C1 - EOR o / ↻ RC2 ea col See also Superba Specials claw	Type C1 - EOR Type C2 - ER part ↔ / part N RC2 ea col	Type C1 - EOR Type C2 - ER △ slip △ / o ↙ 1 RC2 ea col

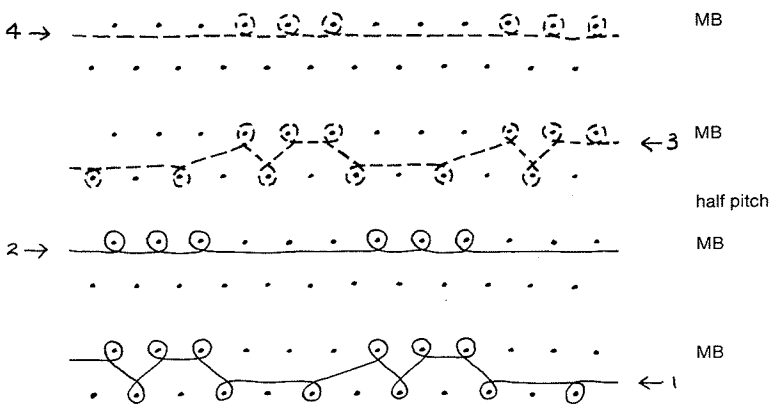


Modified weft with striper backing.

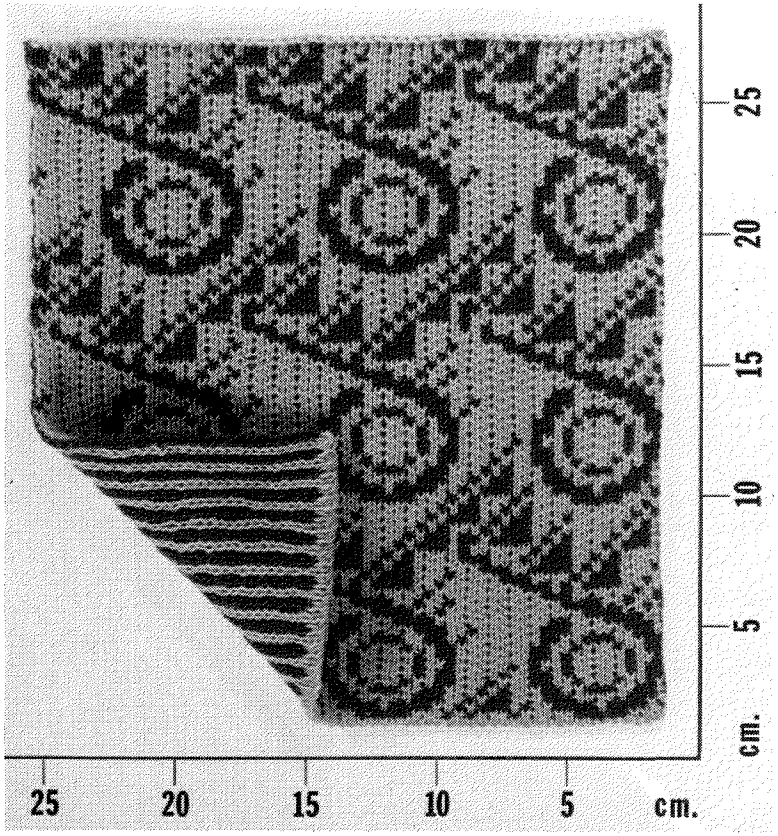


Modified weft with striper backing. Design: jacquard Pattern 12. MB: knit/slip all rows. Second bed: knit 1 row, slip all stitches 1 row. Horizontal stripes on the backing will have only 1 row of each color, as alternating backing rows are omitted. Fabric balance: 2 patt rows = 2 backing rows.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Modified Weft Vertical Stripe Backing **2 rows pattern = 1 row backing**	Type A HX ← push 1x1 WP/RP BX ← Deco 4 RC2 ea col	Type C1 - EOR o / o RC2 ea col. On FB, select odd ndls, RC1; no selection, RC1; select even ndls, RC1; no selection, RC1. claw	Type C1 - EOR Type C2 - ER part ↔ / part ↔ RC2 ea col. On ribber, select odd ndls, RC1; no selection, RC1; select even ndls, RC1; no selection, RC1.	Type C1 - EOR Type C2 - ER △ slip △ / o ← o RC2 ea col. On ribber, select odd ndls, RC1; no selection, RC1; select even ndls, RC1; no selection, RC1.



Modified weft with vertically striped backing.



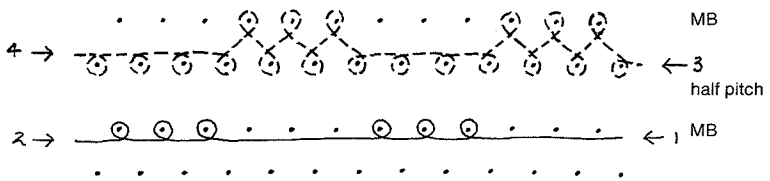
Modified weft with vertically striped backing. Design: jacquard Pattern 12. MB: knit/slip all rows. Second bed: 1x1 knit/slip 1 row, slip all stitches 1 row. Bird's-eye backing always becomes vertical stripes in this fabric, since alternating 1x1 selection knitted EOR causes the 2 colors to always knit on the same needles. Fabric balance: 2 patt rows = 1 row backing.

Variations (not shown). Vertically striped backing can be made knit/tuck instead of knit/slip. Texture of the face (ribs, 2 sts wide) remains unchanged, but the fabric is wider.

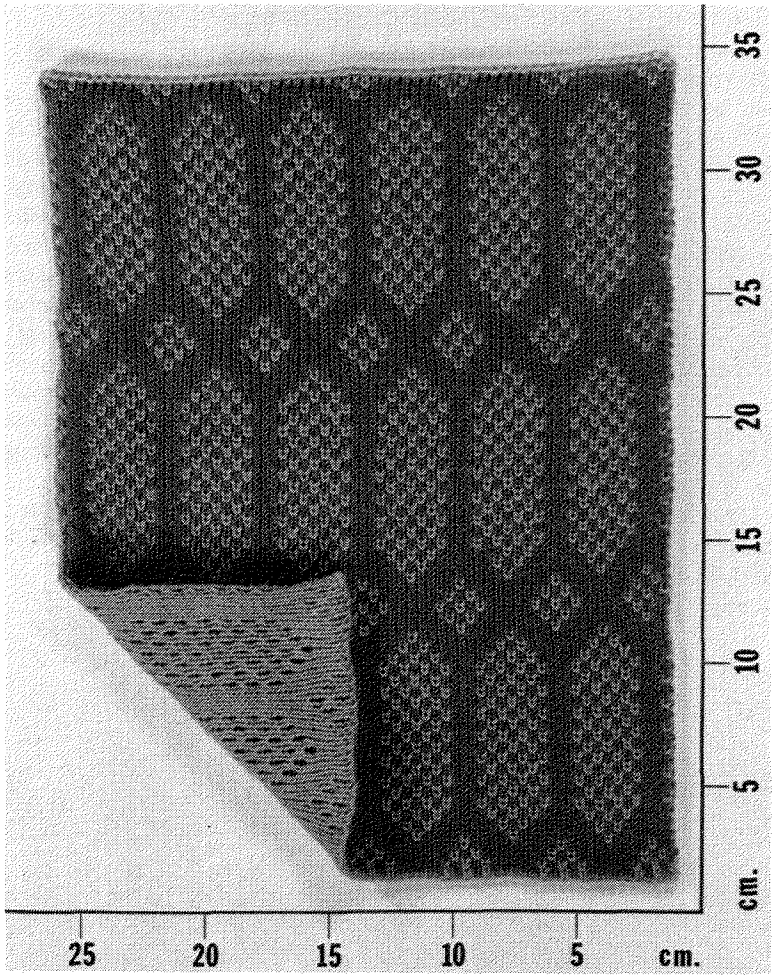
BLISTER FABRIC

Like the modified weft fabrics above, blister fabrics are weft knits with comparatively less stretch in the width. In a two-color blister fabric, color 1 knits selected needles on the main bed only, forming floats across the slipped needles. Color 2 knits both the second bed and the rest of the needles on the main bed. All color 1 floats will be enclosed within the rib of color 2. As a result, the pattern stitches on the main bed, in color 1, are separated from the backing, forming "blisters." The backing will be solid, in color 2.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
	Type A	Type C1 - EOR	Type C1 - EOR Type C2 - ER	Type C1 - EOR Type C2 - ER
Flat or Single Blister **2 rows pattern = 2 rows backing**	BX ← push WP BX ← Deco 4 RC2 ea col	RC2 col 1 o ; o RC2 col 2 o Λ claw See also Superba Specials	RC2 col 1 part ↔ ; part ↔ RC2 col 2 part ↔ N N	RC2 col 1 △ slip △ ; o ← o RC2 col 2 △ slip △ 1 ← 1



Flat or single blister. Extra needle on backing bed.



Flat or single blister. Design: jacquard Pattern 1. MB: knit/slip all rows. Second bed: slip all rows in col 1, knit all rows in col 2. In flat blister, 2 rows are knitted in each color on the MB so both design and background have the same number of rows. Notice that their stitch texture is different, as the blister color is in stockinette and the background color in rib. Fabric balance: 2 patt rows = 2 backing rows.

Variations: See the Blister Jacquard chapter for other ways to knit blister fabrics.

RIB JACQUARD IN TUCK/PLAIN AND TUCK/SLIP COMBINATIONS

Surprising effects can be achieved by combining tucking and slipping, either on alternate rows or on opposite beds. Only a few examples are given here. We expect that by now you have begun to realize the many possibilities of jacquard knitting and will want to create combinations of your own.

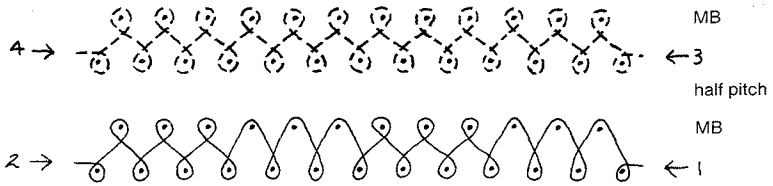
When you experiment, the following reminders about double bed tuck knitting should help you overcome obstacles that may occur:

Tucking on the main bed should always be coupled with either all needles knitting or all needles tucking, or a combination of both, on the second bed. The cam must never be set for slip on the second bed. Since jacquard selection will cause some *adjacent* main bed needles to tuck, the needles opposite them on the second bed must either knit or tuck so the main bed needles that are tucking can retain their loops.

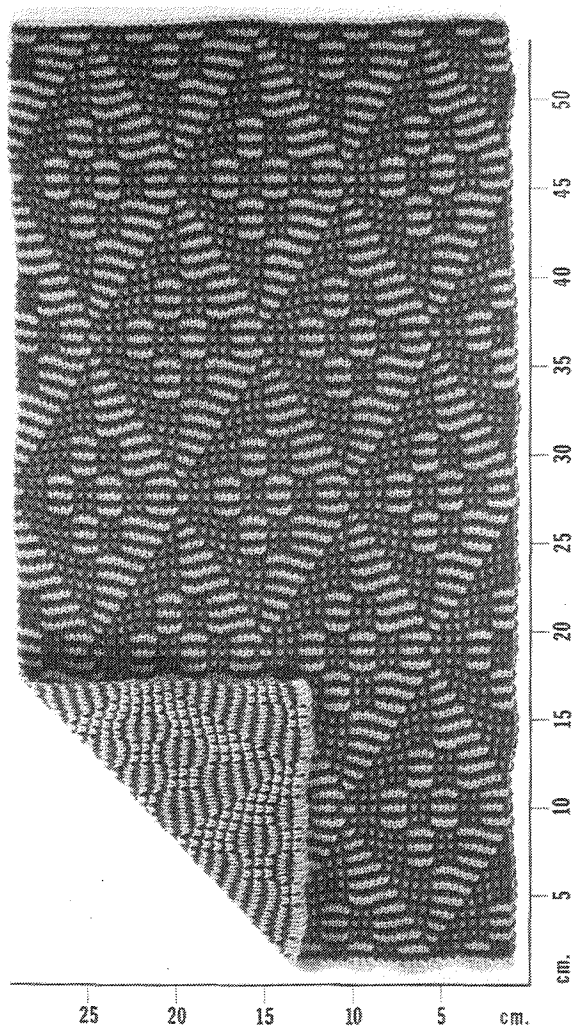
For the same reason, in cases where the main bed is slipping and the second bed tucking, every needle that tucks must have an adjacent needle knitting to hold the loops in place. Since the main bed is knitting and slipping in jacquard, the second bed must be in a 1x1 selection for tucking. This rule can be ignored occasionally if you use 2x1 or 2x2 selection on the second bed (two adjacent needles tucking alternating with one or two needles knitting). Make a careful adjustment in the SS and use extra weights.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Tuck/Plain Combination (Striped Tuck)	Type A RC2 col 1 N / AX← or o ; RC2 col 2 N / N Deco 4	Type C1 - EOR or Type A - stop card; next patt row every RC4 RC2 col 1 ⌒/∧ ; RC2 col 2 ∧/∧ claw	Type C1 - EOR Type C2 - ER Type A - EOR RC2, stop - RC2 RC2 col 1 tuck ↔ / N N ; RC2 col 2 plain / N N	Type C1 - EOR Type C2 - ER Type A - EOR RC2, stop - RC2 RC2 col 1 △ tuck △ / 1 1 ; RC2 col 2 △ stock △ / 1 1

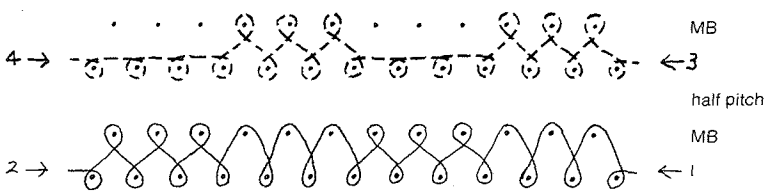
Tuck stitch and plain knitting in alternating colors (striped tuck). Design: jacquard Pattern 5. MB: knit/tuck col 1, knit all sts col 2. Second bed: knit all rows. In this jacquard fabric, col 1 knits the design in a knit/tuck needle selection, while col 2 knits all needles in plain rib. As there is no needle selection on the MB for col 2, these rows on the punchcard are skipped or knitted plain, without selection. On Japanese machines, punchcard Type A can be used. The design appears as a typical tuck jacquard, with vertical ribs in col 2 outlined by the tucks of col 1. The background, however, will be in horizontal stripes of both colors, 2 rows each color, to contrast with the vertical striping of the tucked design. Backing will be a combination of nopps and stripes.
Variation: See Embossed Nopps in the Ripple chapter for another fabric based on this same principle.



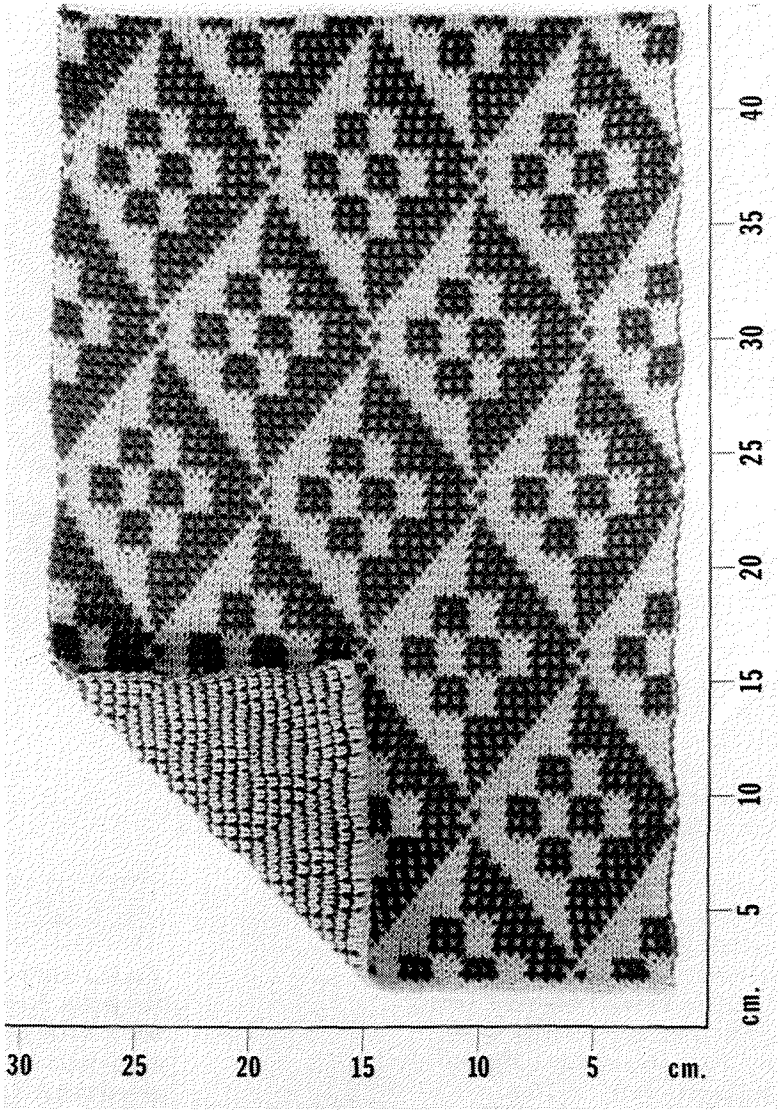
Tuck stitch and plain knitting in alternating colors (striped tuck). Extra needle on backing bed.



	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Tuck/Slip Combination	Type A RC2 col 1 N / AX ← RC2 col 2 N / BX ← Deco 4	Type C1 - EOR RC2 col 1 ⌒ / ∧ RC2 col 2 o / ∧ claw	Type C1 - EOR Type C2 - ER RC2 col 1 *tuck* ↔ ; N N RC2 col 2 part ↔ N N	Type C1 - EOR Type C2 - ER RC2 col 1 △ tuck △ ; 1 1 RC2 col 2 △ *slip* △ 1 1

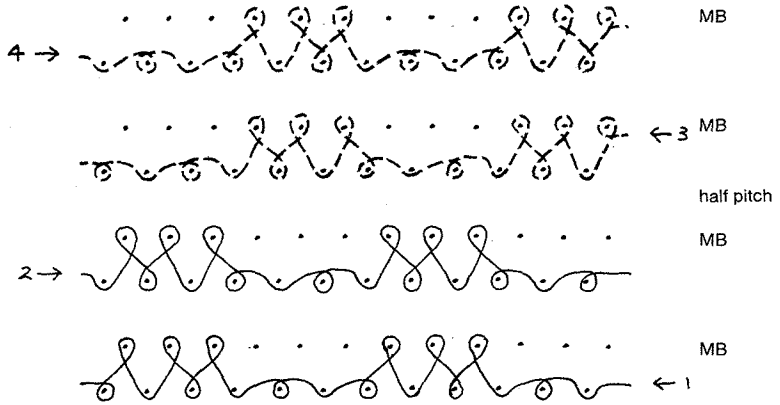


Tuck stitch and slip stitch in alternating colors. Extra needle on backing bed.



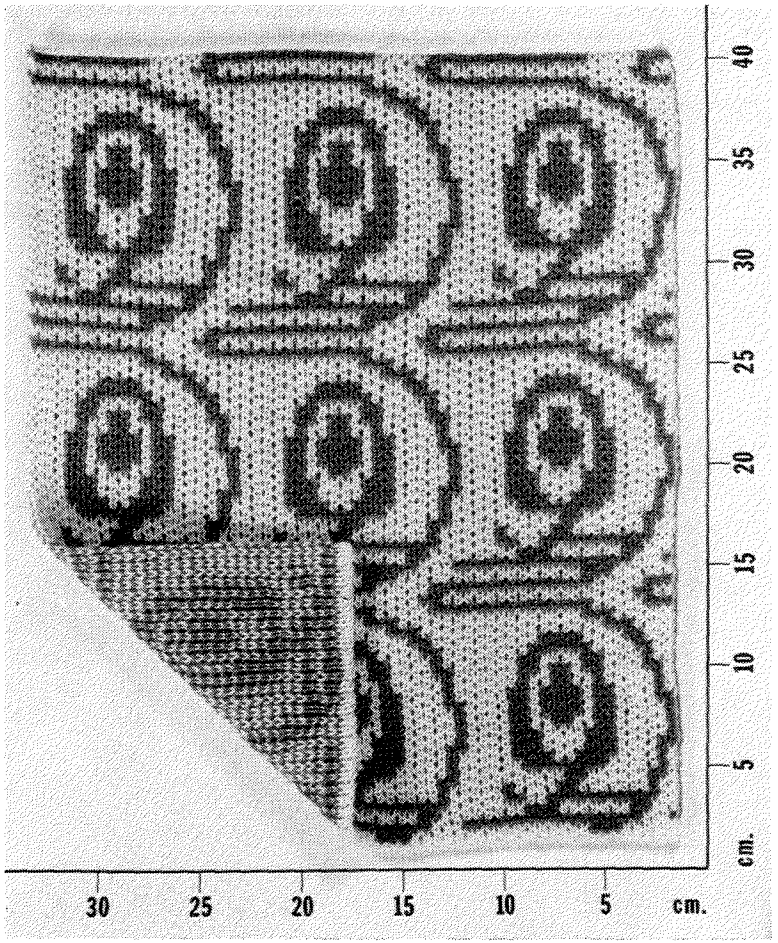
Tuck stitch and slip stitch in alternating colors. Design: jacquard Pattern 5. MB: knit/tuck col 1, knit/slip col 2. Second bed: knit all rows. The appearance and texture of this fabric are much like the striped tuck fabric, except the horizontal stripes are eliminated on the background of the design. Needle selection for MB occurs with both colors, with cams set for slip with one color and tuck for the other color. Either slip or tuck can be knitted first.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Tucked Bird's-eye	Type A AX ↔ push 1x1 WP/RP BX ← Deco 4 RC2 ea col	Type A - Norwegian jacquard Type C1 - EOR o lili ⌒ lili RC2 ea col. Even # ndls FB. claw *See also* Superba Specials	Type B - ER Type C1 - EOR Type C2 - ER part ↔ lili tuck ↔ lili RC2 ea col. Even # ndls ribber.	Type B - ER Type C1 - EOR Type C2 - ER △ slip △ o ⌒ o RC2 ea col. On ribber, select odd ndls, then even ndls, ER.



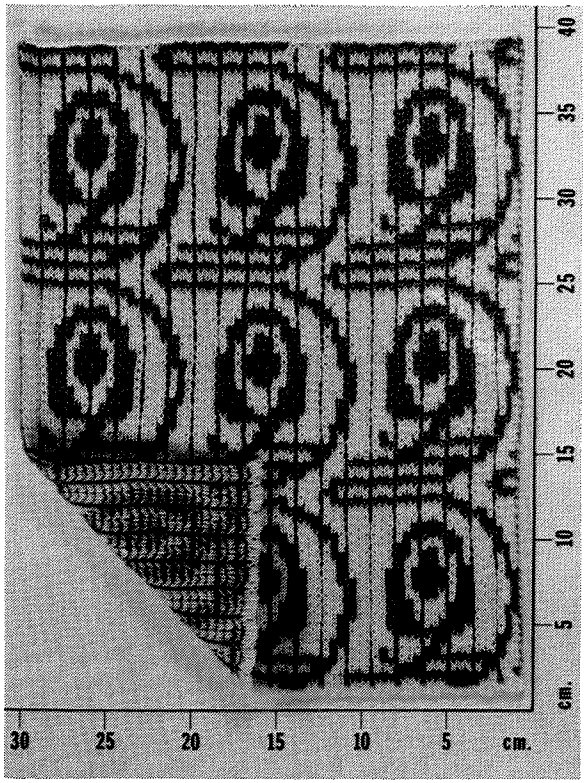
Slip stitch and tuck stitch on opposite beds (tucked bird's-eye).

The swatches on these two pages were made with slip stitch on MB and tuck stitch on second bed. Design: jacquard Pattern 10. MB: knit/slip. Second bed: knit/tuck 1x1, 2x1, etc. All fabrics in this group require needle selection on second bed—1x1, 2x2, 1x2—all of which will cause stitches on the MB to divide into various kinds of ribs. The MB knits with a knit/slip cam setting for all fabrics in this group. By using a knit/tuck cam setting on the second bed, a variety of textured ribs can be designed on the face, from wide, straight ribs to narrow, wavy ribs, to nopps. Many will have textured backings as well. Remember, the finer the yarn, the more tuck loops each backing needle can hold.

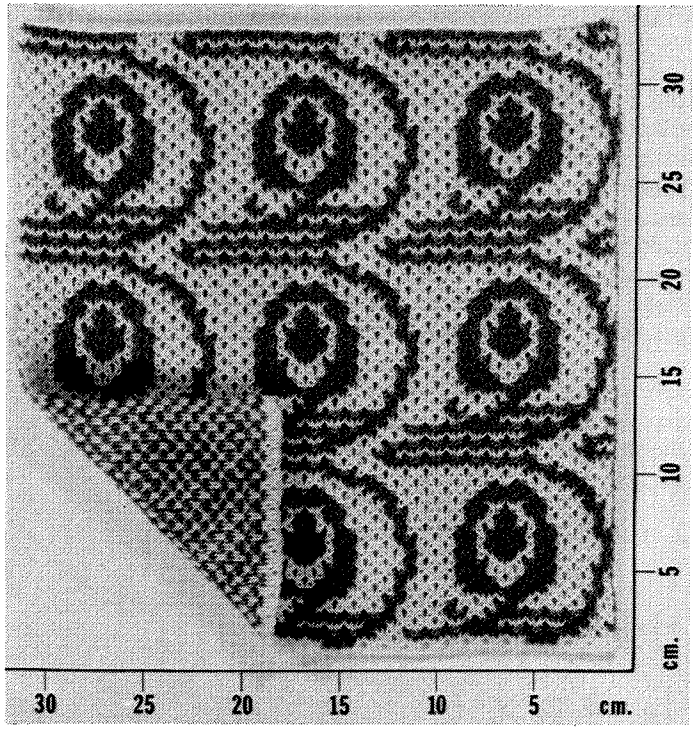


Tucked bird's-eye. Design: jacquard Pattern 10. This is the basic fabric in this group. It resembles regular bird's-eye backing, but the fabric is wider and has a softer texture. Backing needles alternate in 1x1 knit/tuck selection every row; the face is made knit/slip as in regular bird's-eye. The best proportion is 2 knitted rows per patt row.

Variations. Design: jacquard Pattern 10. MB: knit/slip. Second bed: knit/tuck 1x1, 2x2, 2x1. All variations are made on the second bed only, by changing needle selection and number of rows knitted with each selection before alternating. The best proportion is 2 knitted rows per patt row.

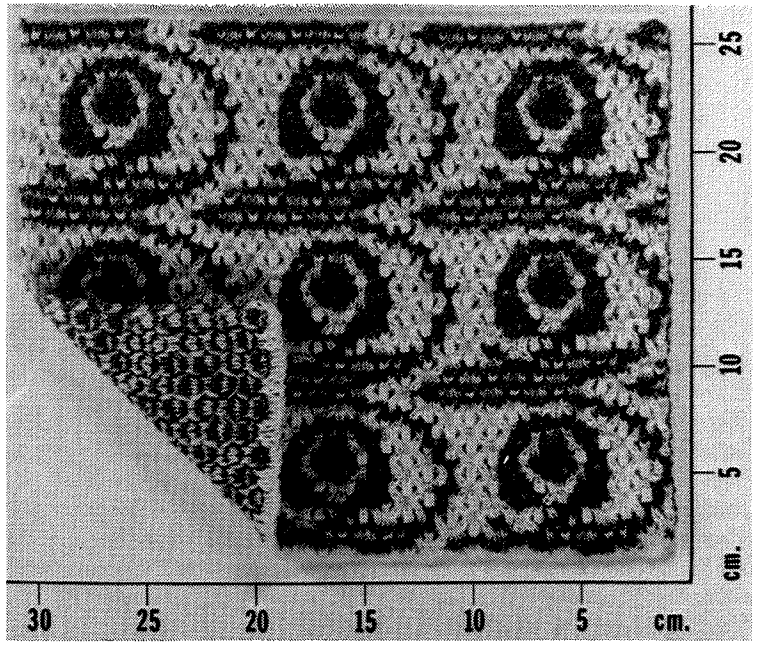


Ribbed fabric face created by 2x1 selection (2 knit, 1 tuck) on backing. Design: jacquard Pattern 10. Selection does not alternate, but is maintained throughout. On every 4th row (the last row of col 2) the cam on the second bed is set for plain knitting to knit off the loops.



Checked backing with 1x1 needle selection alternating every 4 rows. The face is a wavy rib. Design: jacquard Pattern 10.

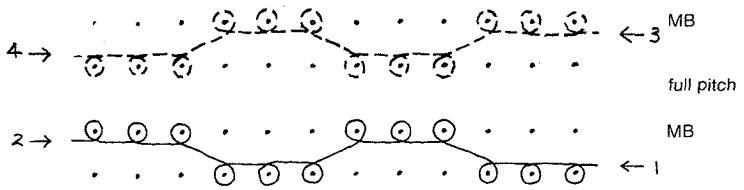
Nopped fabric face created by 2x2 selection on backing, with 8 consecutive rows each selection. Design: jacquard Pattern 10.



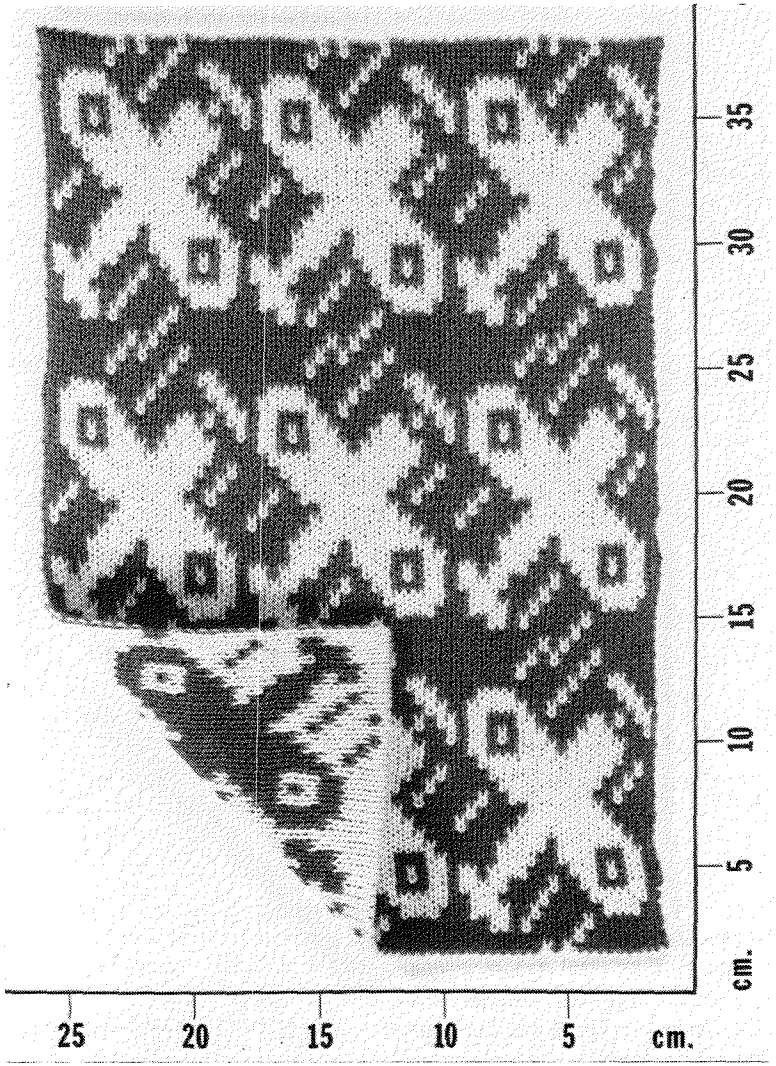
REVERSIBLE JACQUARD FABRICS

To make a jacquard fabric with two "right" sides and with the design back to back, the same needle selection for the jacquard pattern must occur on both beds simultaneously. The punchcard in the pattern reader will select the needles for the main bed as usual, and a Jac 40, pattern ruler, or manual selection can be used to select needles for the same pattern on the second bed. Or, you can use one card and a Jac for both beds. When a knit/slip cam setting is used, it is possible to knit both faces of the fabric with the design and background colors exactly the same or exactly reversed. With a knit/tuck setting, the colors must always be reversed, although the fabric texture can be the same or reversed. In all cases, the stitch and row gauges on both beds must be the same.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Eightlock (Double Jersey)	Type A BX ← Jac / BX ← Deco 4 RC2 ea col. Back bed: pushers in WP, select with Jac to RP every RC4.	Type C1 - EOR Type C1 - Jac o / o RC2 ea col. On FB, move all ndls to pos 2, select with Jac to pos 1 ER, rotate card EOR. claw	Type C1 - EOR Type C2 - ER Type C1 - Jac part ↔ / part ↔ RC2 ea col. Ribber: move all ndls to D pos, select with Jac to B pos, ER, with rotation EOR.	Type C1 - EOR Type C2 - ER Type C1 - Jac △ slip △ / o ← o RC2 ea col. Ribber: move all ndls to C pos, select with Jac to B pos ER, with rotation EOR.

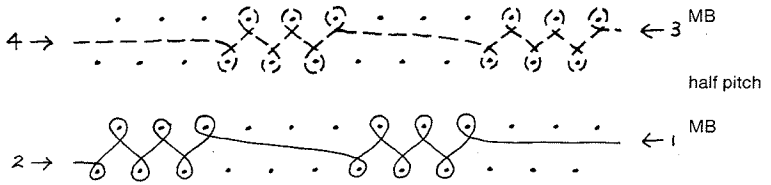


Eight-lock or double jersey.



Eight-lock or double jersey. Design: jacquard Pattern 8. Both beds: knit/slip. Colors are reversed on each face. Opposite needles are selected on each bed. This fabric is really two jersey jacquard fabrics, one knitted on each bed, interlocked only at the points where the design/background colors change. There are no floats within the fabric. Col 1 knits the design on one bed and the background on the other bed at the same time, while col 2 knits just the reverse. To accomplish this reversal, design needles are selected on one bed along with the background needles for the same pattern row on the other bed to knit with col 1, then the selection is exactly reversed for col 2. Beds are set at full pitch. You'll find more on eight-lock in Chapter 5.

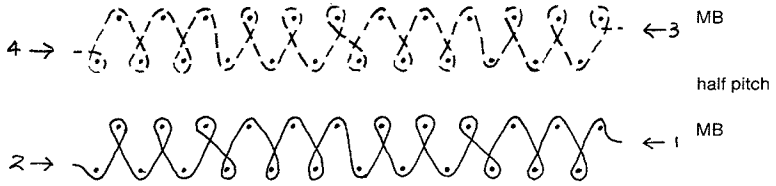
	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Reversible Weft	Type A BX ← Jac / BX ← Deco 4 RC2 ea col. Back bed: pushers in RP, select with Jac to WP every RC4.	Type C1 - EOR Type C1 - Jac o / o RC2 ea col. On FB, select ndls with Jac to pos 2 ER, rotate card EOR. claw	Type C1 - EOR Type C2 - ER Type C1 - Jac part ↔ / part ↔ RC2 ea col. Ribber: select ndls with Jac to D pos ER, with rotation EOR.	Type C1 - EOR Type C2 - ER Type C1 - Jac △ slip △ / o ∠ o RC2 ea col. Ribber: select ndls with Jac to C pos ER, with rotation EOR.



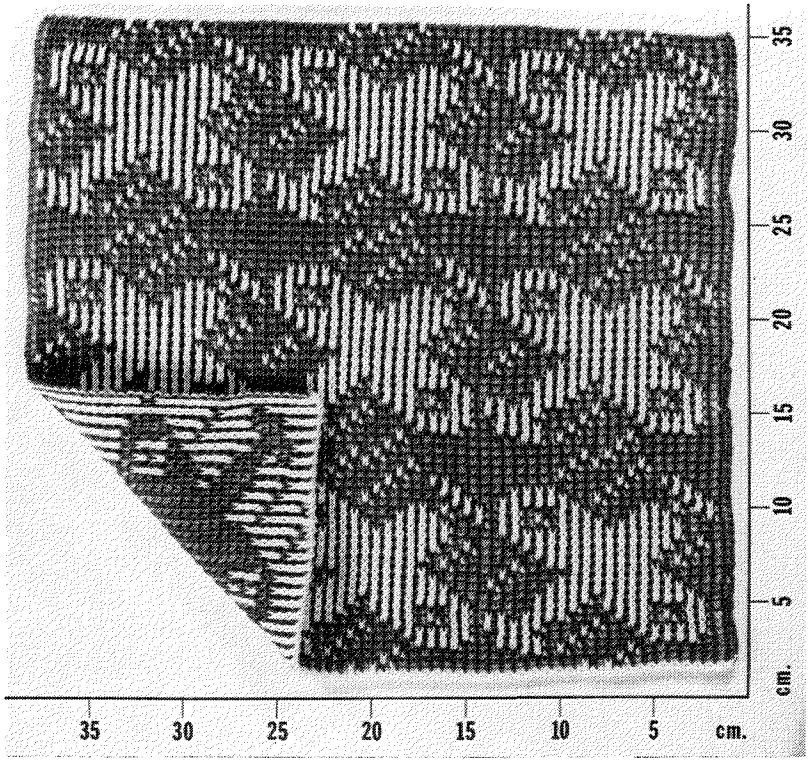
Reversible weft.

Reversible weft. Design: jacquard Pattern 8. Both beds: knit/slip. Colors the same on each face; same needles are selected on both beds. Since the same needles are selected on both beds for both design and background colors, both sides of the fabric will be exactly alike; there will be no color reversal. Each color will have floats, enclosed by the knit stitches of the opposite color. As with all weft knit fabrics, this one has less stretch across the width. Note the method of needle selection used here is exactly the opposite that used in eight-lock. Beds are set at half pitch. Put an extra needle in WP on one bed on the side opposite the color changer and hook the weft yarn around it each time the carriage passes it, to carry the weft completely across the fabric.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Reversible Tuck	Type A AX ← Jac / AX ← Deco 4 Knit same as Eightlock	Type C1 - EOR Type C1 - Jac Knit same as Eightlock claw	Type C1 - EOR Type C2 - ER Type C1 - Jac tuck ↔ / tuck ↔ Knit same as Eightlock	Type C1 - EOR Type C2 - ER Type C1 - Jac △ tuck △ o ∩ o Knit same as Eightlock

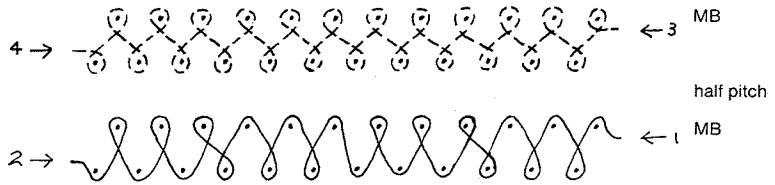


Reversible tuck.

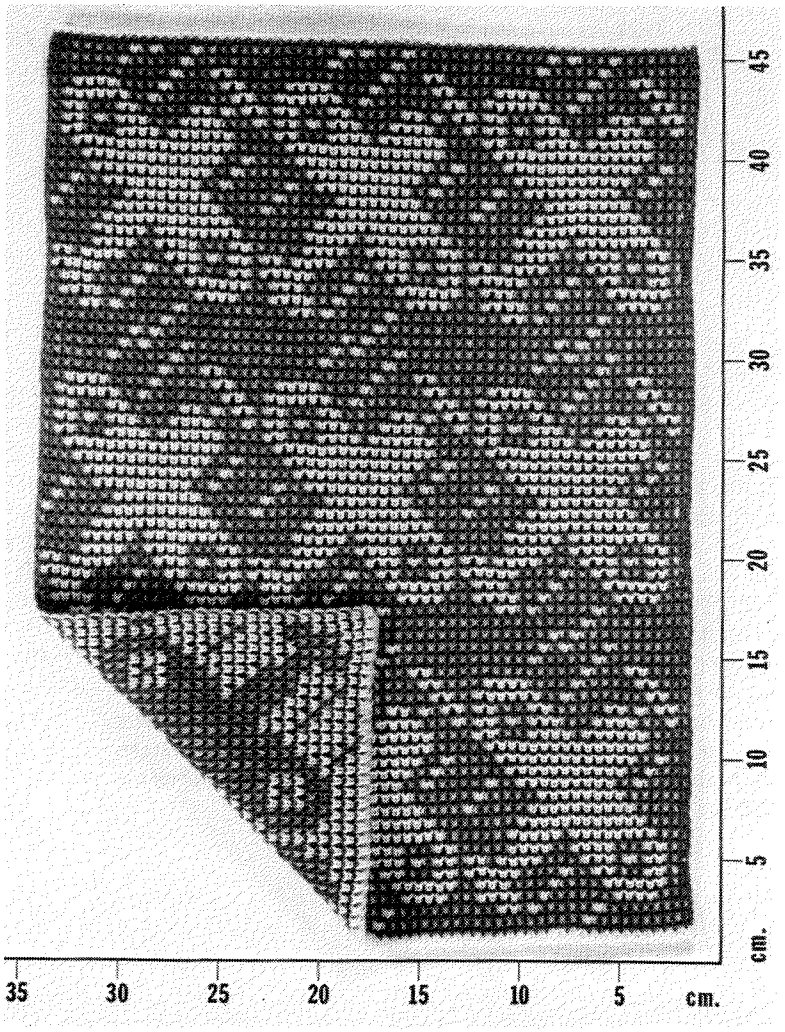


Reversible tuck. Design: jacquard Pattern 8. Both beds: knit/tuck. Colors reversed each face. Opposite needles selected on each bed. This fabric has the appearance and texture of basic tuck on both sides of the fabric, with colors reversed. The technique is the same as for eight-lock, but with beds at half pitch and cams set to tuck.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Reversible Striped Tuck	Type A RC2 col 1 AX ← or o ; AX ← or o RC2 col 2 N Jac ; N Deco 4 RC2 ea col. Back bed: pushers in WP, select with Jac to RP every RC4.	Type C1 - EOR Type C1 - Jac or Type A - stop card; next patt row every RC4 Type A - Jac RC2 col 1 ∩ ; ∩ RC2 col 2 ∧ ; ∧ FB: move all ndls to pos 2, select with Jac to pos 1, ER, with col 1 only. claw	Type C1 - EOR Type C2 - ER Type A - EOR RC2, stop RC2 Type A - Jac RC2 col 1 tuck ↔ ; tuck ↔ RC2 col 2 plain ; N tuck N Ribber: move all ndls to D pos, select with Jac to B pos, ER, with col 1 only.	Type C1 - EOR Type C2 - ER Type A - EOR RC2, stop RC2 Type A - Jac RC2 col 1 △ tuck △ ; o ∩ o RC2 col 2 △ stock △ ; 1 ∩ 1 Ribber: move all ndls to C pos, select with Jac to B pos, ER, with col 1 only.



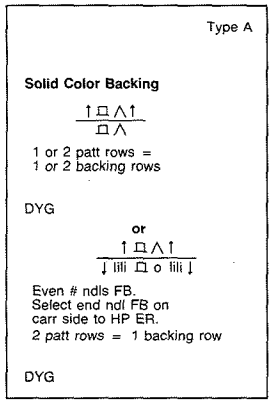
Reversible striped tuck.

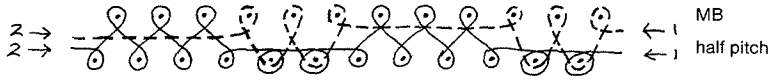


Reversible striped tuck. Design: jacquard Pattern 8. Both beds: knit/tuck, col 1; knit all sts col 2. Colors and stitch texture reversed each face. Opposite needles selected each bed. The technique for striped tuck can be used here for a fabric with both color and texture reversal, but without stripes. Needle selection occurs only with col 1—the design needles on one bed and background needles for the same pattern row on the other bed. Col 2 knits plain across all needles. The result is a nopped design against a vertically ribbed background on one side of the fabric, and a vertically ribbed design against a nopped background on the other side, with colors reversed as well.

SUPERBA SPECIALS: RIB JACQUARD MADE WITH DOUBLE YARN FEED

Superba machines can make all the fabrics described above, and also have the capability of using the double feed method, with the second yarn guide unit, to knit two-color jacquard fabrics. Because the backing is constructed in a different way, these fabrics are unique to Superba. There are two basic kinds of backings: plated and solid color. Techniques for making them are described below.





Solid color backing, for Superba only.

Solid color backing. Design: jacquard Pattern 3. The cam setting for the MB carr is the usual jacquard setting. When the jacquard key on the front carriage is used, col 1 in the main feeder will knit its own stitches on the MB and all the needles on the backing. Col 2, in the double yarn guide, is carried as a weft behind col 1 stitches on the MB. At the same time, it knits its own stitches on the MB and tucks on the backing needles behind the stitches it is knitting on the MB. This fabric construction causes col 2 stitches to puff out in slight relief on the face. The backing may be knitted with all needles knitting every row; fabric balance: 1 patt row = 1 backing row. The backing may be knitted with 1x1 selection on the backing; fabric balance: 2 patt rows = 1 backing row for a bird's-eye texture with slightly more relief on the face. This fabric is not recommended for patterns with long floats, as they tend to get caught in the backing needles during knitting. It knits best with heavier yarns. To ensure that both yarns are carried completely to each selvedge, set the needle return buttons on the front carriage to the lower position, and select the end ndl on the carr side to HP at the start of each row.

Type A

Plated Backing

↑ ⊓ ∧ ↑
∧

DYG

1 or 2 patt rows =
1 or 2 backing rows

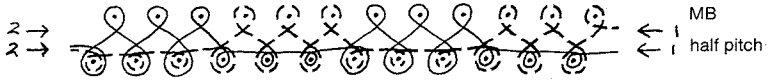
or

↑ ⊓ ∧ ↑
lili o lili

Even # ndls FB.

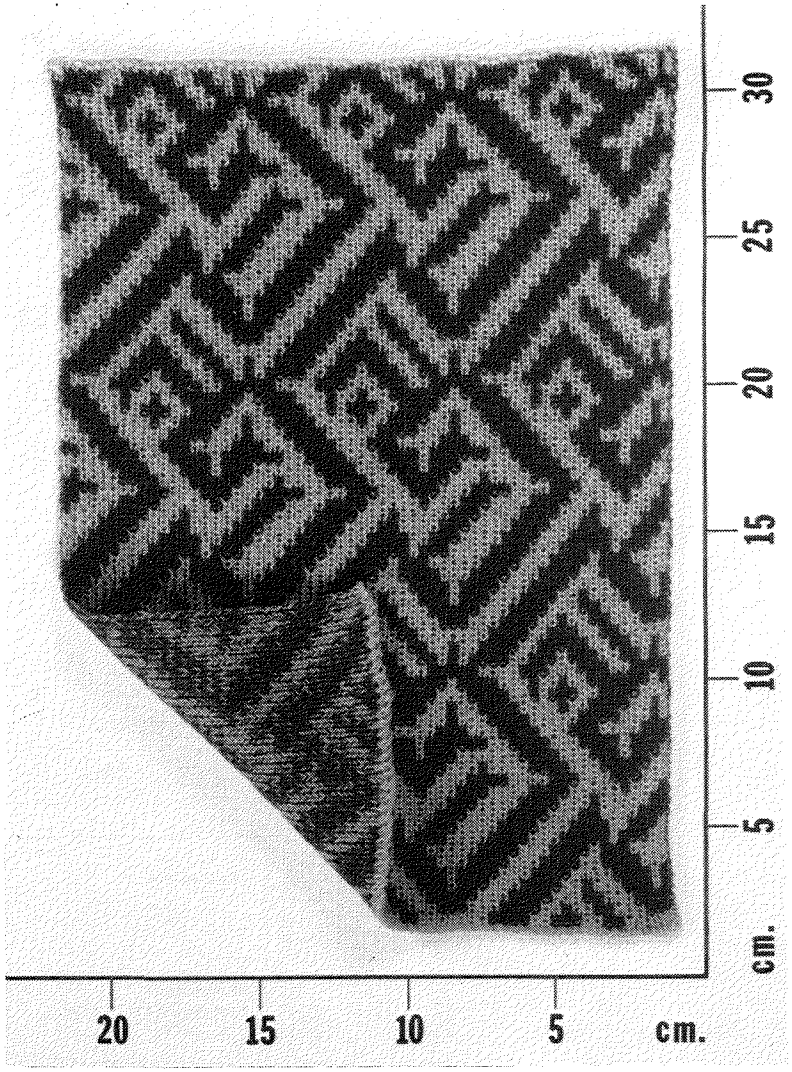
2 patt rows = 1 backing row

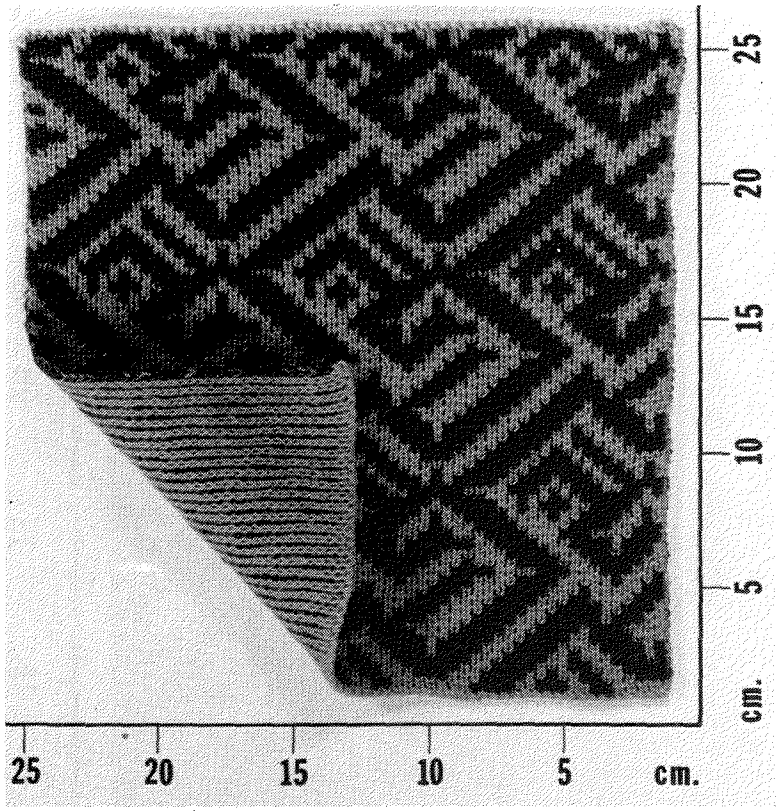
DYG



Plated backing, for Superba only.

Plated backing. Design: jacquard Pattern 3. The cam setting for the MB carr is the usual jacquard setting. The jacquard key on the front carriage is not *used. There are no wefts in this backing and the face of the fabric is smooth. Both colors knit together in a plating relationship on the backing needles on the front bed. The design on the face will be shadowed on the backing, and the SS on the backing must be large enough to accommodate both yarns. It may be knitted with all needles knitting every row on the backing, or with 1x1 selection, which will cause the face to divide slightly into vertical ribs. The fabric balance is the same as for the solid color backing. This backing must be made with finer yarns only. Both solid and plated backings can be knitted easily with either 1 or 2 knit rows per pattern row.*





Modified weft.

Type A

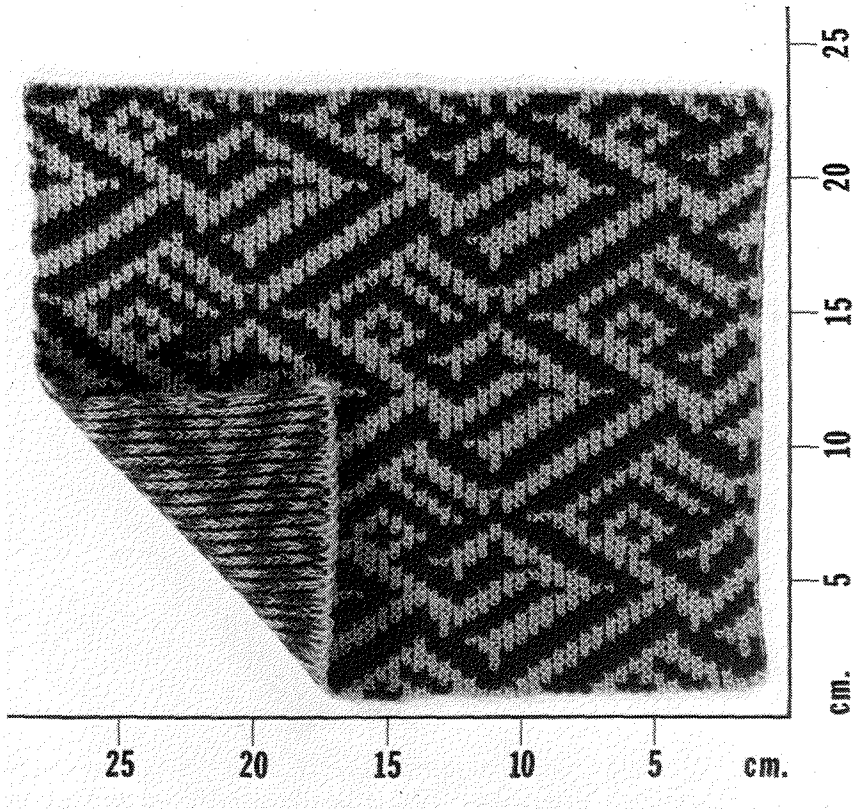
Modified Weft

↑□∧↑
↓□⊃↓

Select end ndl FB on carr side to HP every row.

2 patt rows = 1 backing row

DYG



Tucked bird's-eye.

Type A

Tucked Birds-eye

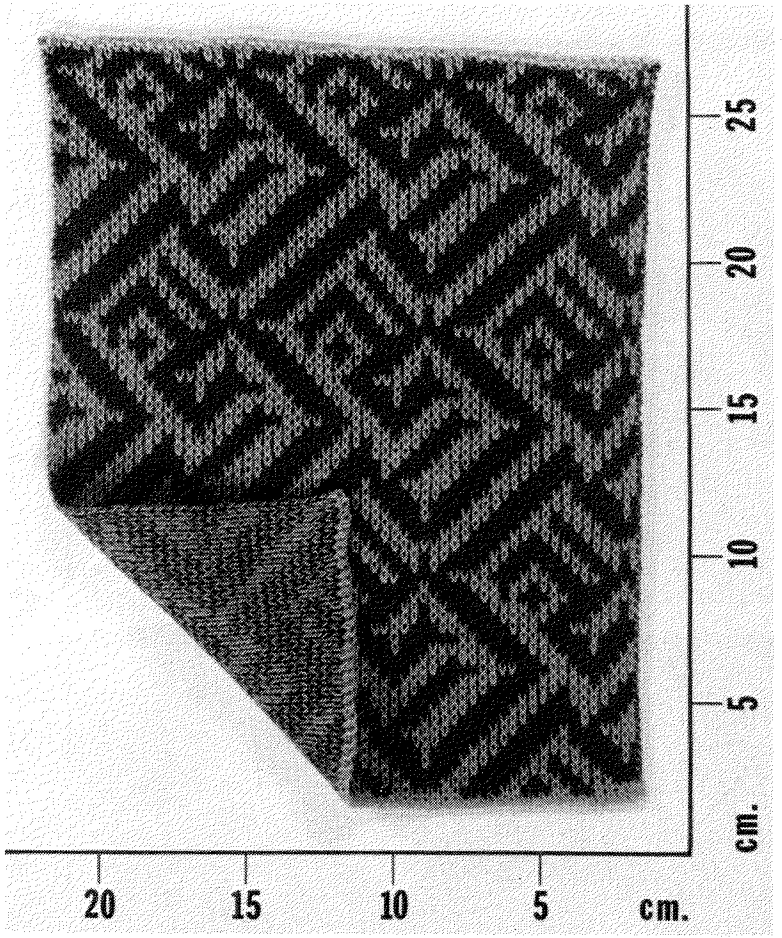
↑□∧↑
lili ⌒ lili

Even no ndls FB.

2 patt rows = 1 backing row

DYG

The photos on these two pages show variations for both solid color and plated backing. The usual cam setting on the MB can be varied with the tubular setting, and, coupled with the use or non-use of the right cursor stop, other fabrics similar to those already discussed can be invented. The tubular setting may be used on the second bed, incorporated into either a plated or solid backing, and the tuck setting may also be used on the second bed with 1x1 selection.



Half Milano.

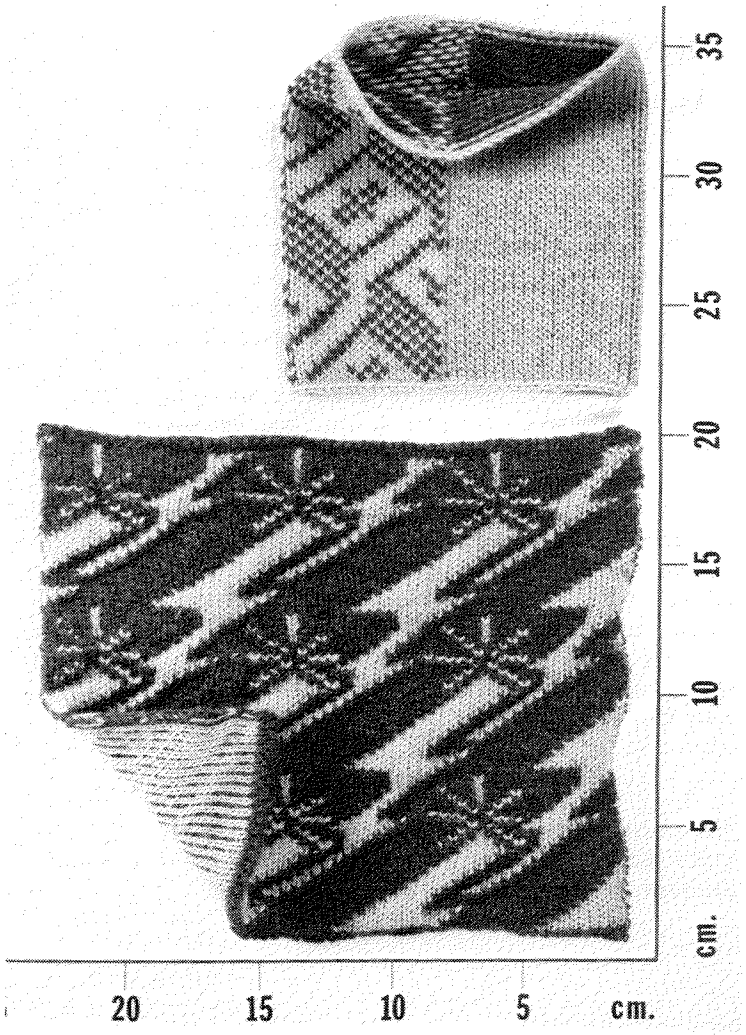
Type A

Half Milano

↑⊓⊂↑
/\

No right cursor stop, cursor at carr R. Start carr L.
1 patt row = 2 backing rows

DYG



Top: tubular jersey jacquard. Bottom: blister jacquard.

Type A
EOR

Tubular Jersey Jacquard

Tubular Jacquard/plated stockinette

↑⊓⊂↑ / ↄ — No R cursor stop. Cursor at carr R.

DYG

Type A
EOR
neg rev

Blister Jacquard

↑⊓⊂↑ / ↓⊓ↄ↓ — Select end ndl FB on carr side to HP ER.

DYG

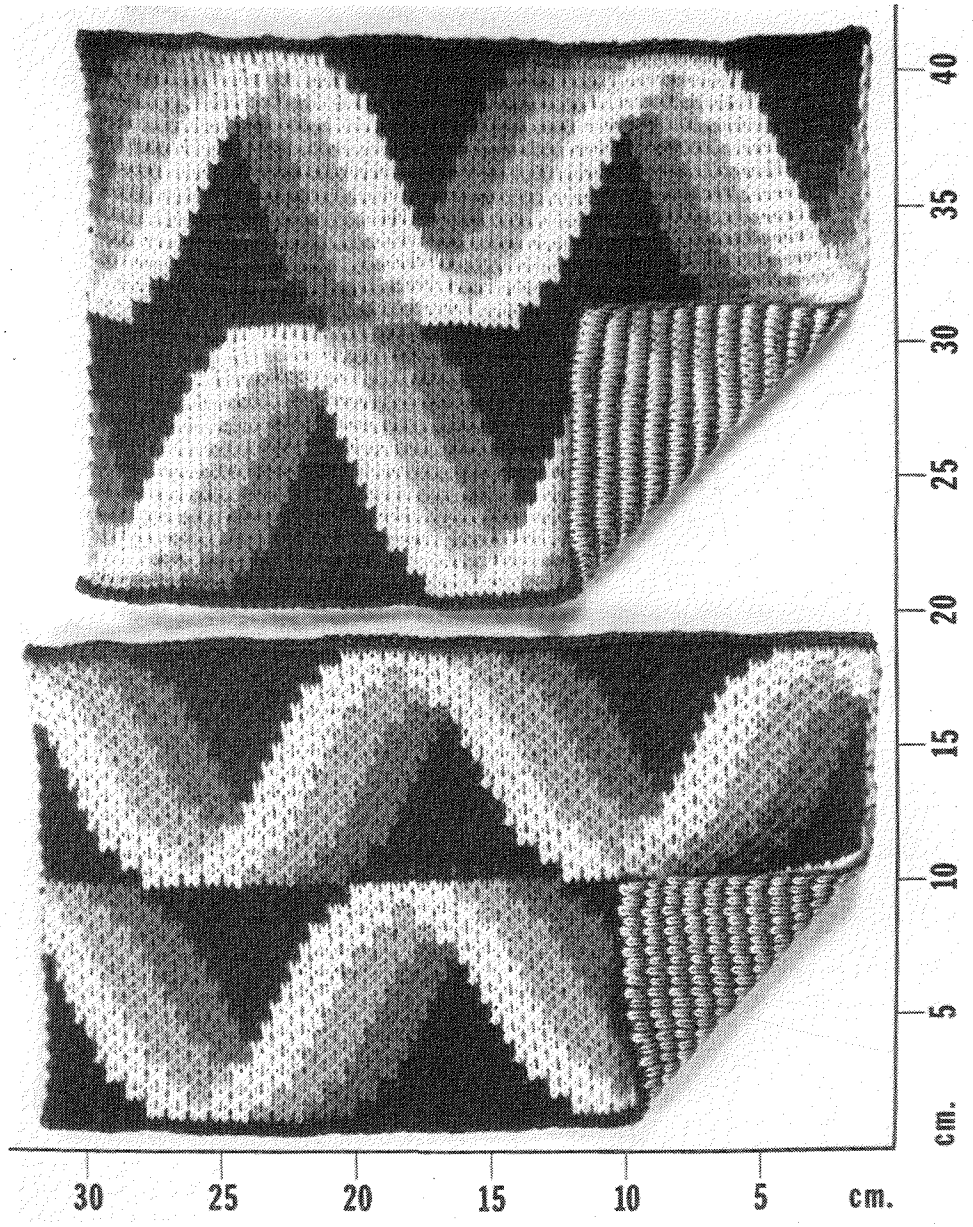
RIB JACQUARD KNITTING WITH THREE AND FOUR COLORS PER ROW

All the techniques in this chapter can be used to some extent with patterns having three or four colors per row. Keep in mind that for every additional color there will be more rows in the backing, which results in extra bulk and a thicker, tighter fabric. Some techniques, such as those for bird's-eye, flat blister and modified weft, are suitable for reducing bulk, while others, like those for basic tuck, striper, Half Milano and slip/tuck combinations, make use of the extra bulk to create heavily textured backings.

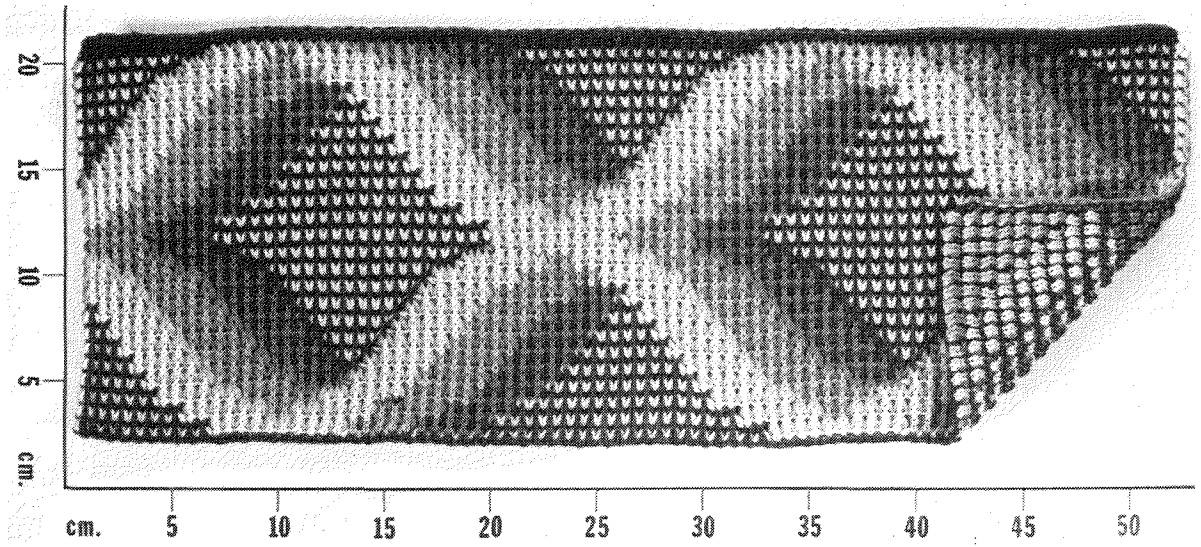
Fine yarn should be used to knit three and four colors with the tuck setting on the main bed, because some needles will have to collect up to eight or more loops before knitting off. In three- and four-color work, basic tuck and Half Milano are less suitable for the Japanese machines than modified weft and bird's-eye because they lack strippers to push the extra stitches down, but striper backing knits easily and makes a texture similar to Half Milano.

The techniques used for the swatches below are the same as their counterparts knitted in two colors. They were knitted with a Type D card set to rotate every other row.

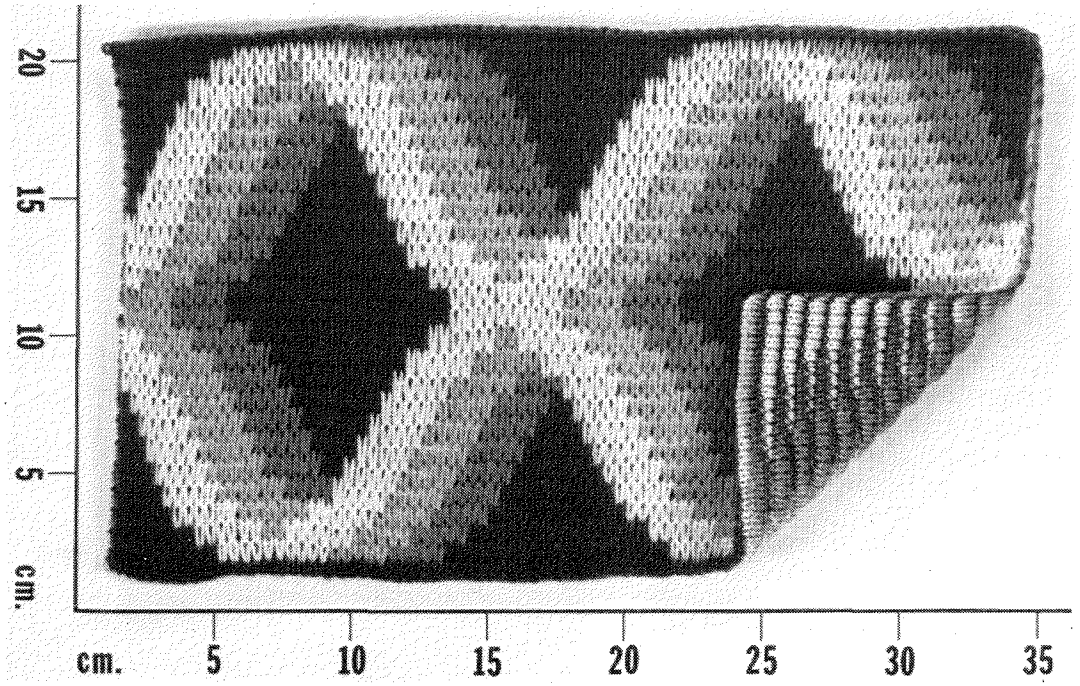
On these three pages are examples of three-color and four-color jacquard, knitted with jacquard Patterns 13 and 14.



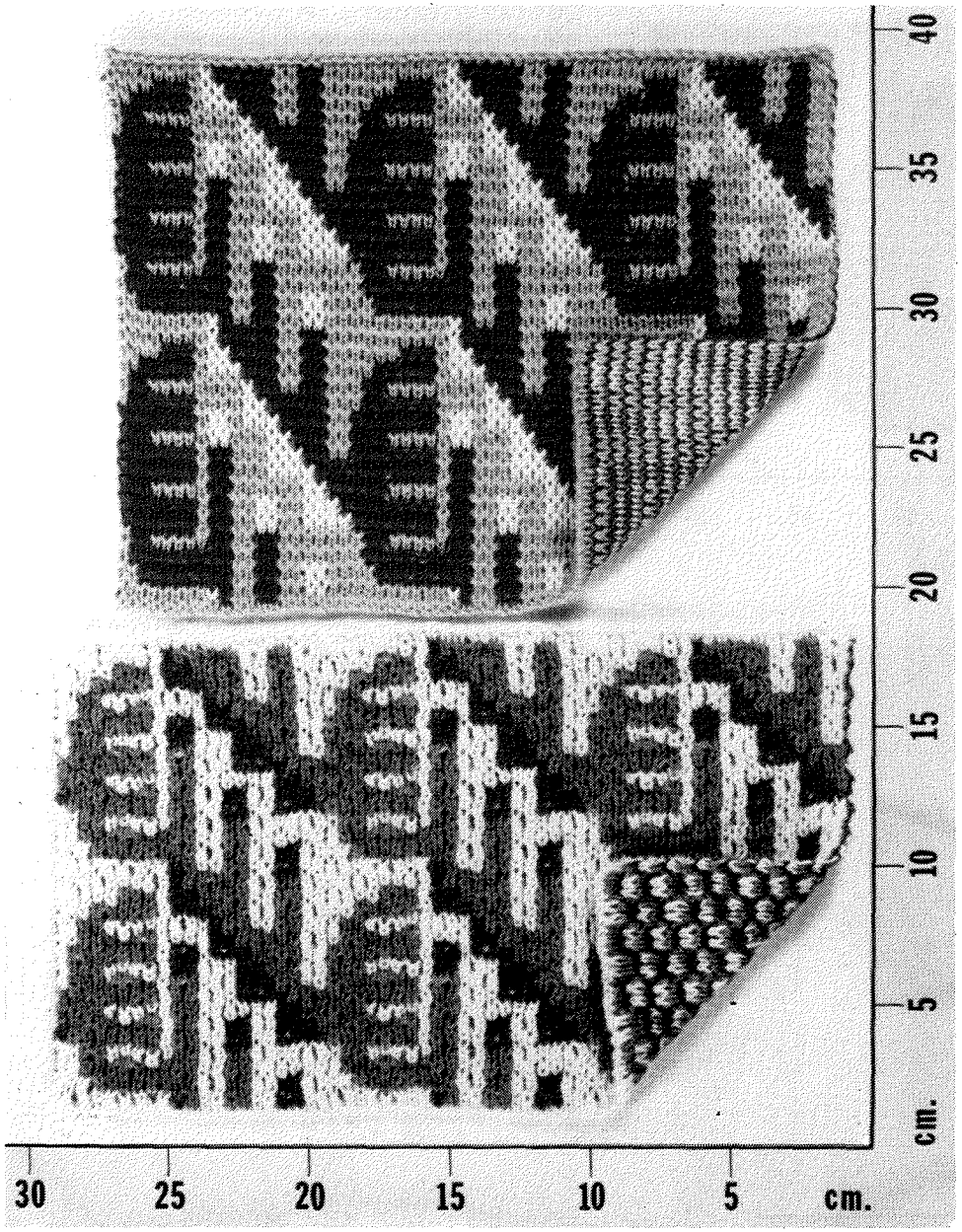
Four colors per pattern row. Design: jacquard Pattern 14. Top: striper backing. Card turned backwards for 2nd repeat. Bottom: bird's-eye backing.



Basic tuck. Card turned upside down for 2nd repeat. Design: jacquard Pattern 14.

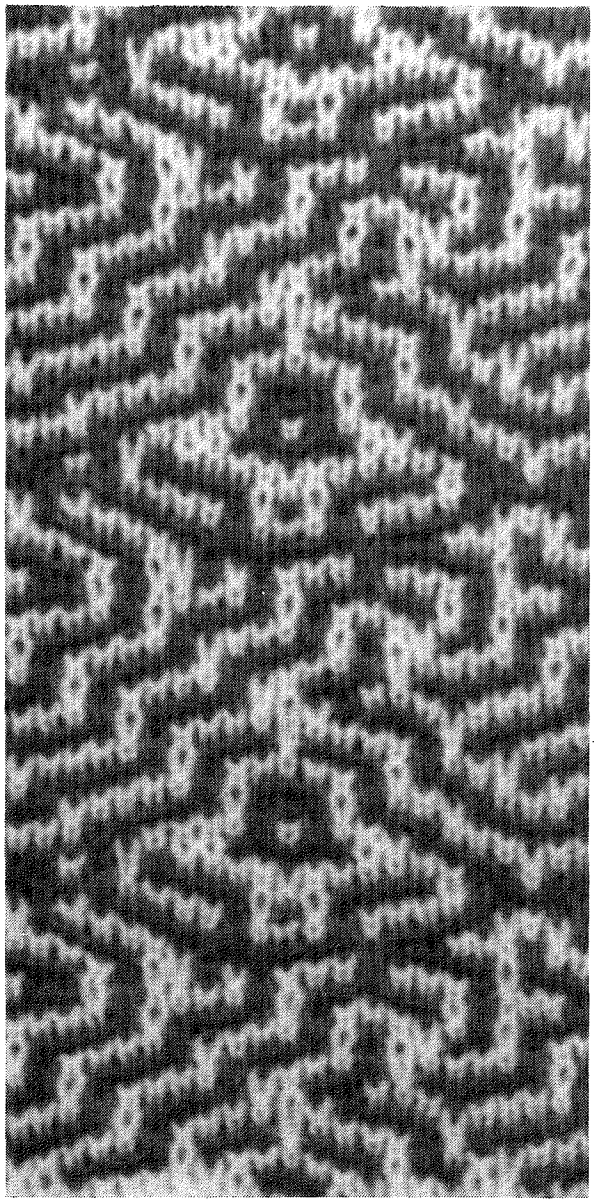


Half Milano. Card turned upside down for 2nd repeat.
Design: jacquard Pattern 14.



Three colors per pattern row. Design: jacquard Pattern 13. Top: modified weft with striper backing. Bottom: MB slip/knit; second bed tuck/knit 2x2 backing. Knit 6 rows with same 2x2 selection, then alternate.

CHAPTER 2
Mosaics



Mosaic or maze patterns are variations of jacquard knitting that produce flat single or double bed fabrics. The patterns are composed of narrow vertical and horizontal stripes that intersect, and which may look like complex mazes. The name for these patterns was coined by Barbara Walker, and is used in her books on hand knitting.

This technique, which incorporates either tuck or slip stitches to make the pattern, is also known as *skip stitch* or *slip knitting*. If you are especially fond of geometric designs, you can extract a great deal of mileage from just one jacquard card, typically a jersey jacquard card, punched to knit a geometric pattern in two colors, although there are limitations in the choice of jacquard design.

Creating a mosaic pattern can seem very mysterious. A jersey jacquard card can be punched with a perfectly visible, clearly defined geometric design, and yet will knit a mosaic pattern bearing no resemblance whatsoever to the parent pattern. There is no reliable way to visualize what a parent card's offspring will look like—you just have to knit it.

Here is what happens when a jersey jacquard card is used to knit a mosaic pattern. First, the typical jersey jacquard pattern knits needles corresponding to punched holes with color 1 and needles corresponding to unpunched spaces with color 2. But with a mosaic pattern, punched holes cause needles to knit whichever color is in the carriage; the unpunched spaces cause needles to slip or tuck. This is the rule for Japanese machines; for European machines, which use the arrow key or reverser, it is just the reverse.

The fabric is constructed as follows: color 1 knits the selected needles in the first pattern row, while slipping or tucking the non-selected needles. Color 2 knits the selected needles in the second pattern row, while slipping or tucking non-selected needles. This alternating stripe pattern continues throughout the repeat, for which a color changer is a very handy accessory. The alternating color change on the needles that knit in each pattern row produces the horizontal stripes in the mosaic, while the needles that slip, or tuck, create the vertical stripes. In some patterns, certain needles must slip or tuck for several successive pattern rows, resulting in long vertical stitches and at the same time forcing some of the horizontal rows to have a diagonal or curved appearance. In single bed work the reverse of the fabric will show the original punchcard design in the texture of its slip or tuck stitches. In fact, the technique of mosaic knitting is nothing more than simple one-color tuck or slip patterning done in two-colored stripes. Furthermore, there will be no floats longer than one or two stitches on the reverse. The fabric will be unbalanced because the number of needles slipping or tucking is not necessarily the same on every row. If the fabric becomes very unbalanced, parts of it will pucker, which may or may not be a design advantage.

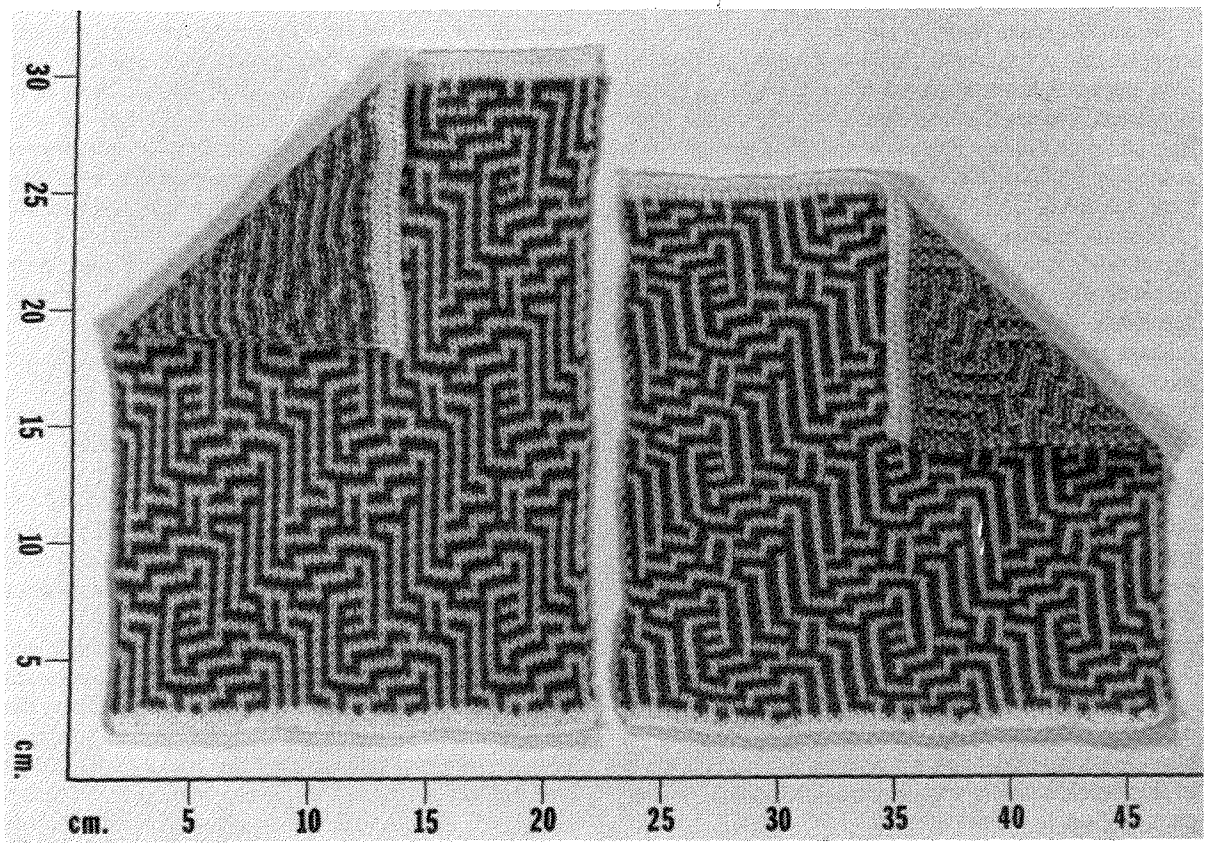
JACQUARD PATTERNS FOR MOSAICS: GROUP 1 AND GROUP 2 PATTERNS

Punchcards suitable for mosaics are the Type A-1 and A-2 cards discussed in Reference Chapter 4. The designs on these cards which are suitable for mosaics can be divided into two groups.

Group 1 mosaic patterns are those in which one needle at a time slips or tucks, with at least one adjacent needle on both sides knitting. In most patterns, the needles which slip or tuck will change every pattern row or every two pattern rows, so that a given needle will not slip or tuck more than two rows. Usually, single bed mosaic fabrics are knitted with patterns from this group. An example is jacquard Pattern 2, used to knit some of the swatches illustrated in this chapter.

These are the most common jacquard patterns for mosaics and are the same patterns used for regular one-color tuck or slip knitting. Examples of these patterns are supplied with all machines, and most knitting machine stitch pattern books have beautiful examples in two, or sometimes three and four, colors. If you wish to design your own patterns, read the directions at the end of this chapter.

Group 2 mosaic patterns are those in which more than one adjacent needle slips or tucks. The best jacquard patterns are those in which at least three or four adjacent needles slip or tuck more or less consistently throughout the pattern. The design should have stronger diagonal and/or horizontal elements than vertical. Usually, double bed mosaic fabrics are knitted with these cards. Jacquard Pattern 3 is an



Example of a Group 1 mosaic pattern (jacquard Pattern 2), knitted single bed.
Left: knitted with slip stitch cam setting.
Right: knitted with tuck stitch cam setting.

example of a Group 2 pattern, and knitted swatches from it are illustrated further along in this chapter.

It is essential that no given needle slip or tuck more than six or eight rows, or the fabric will become too unbalanced and will be difficult to knit. To check, count the vertical spaces on your card which will tuck or slip. If there is only an isolated stitch that will slip or tuck more than eight rows, try the card anyway. The stitch may stretch and hold, or your particular machine and yarn may be able to handle that many tuck loops at once. Or you may need to tape over or punch out a hole here and there to compensate. This is the same kind of pattern, with the same limitations, as that used for punch pin tuck and punch nopps (discussed in Chapter 3, Ripple Fabrics).

TECHNIQUES FOR KNITTING MOSAICS

Mosaic patterns tend to be small and complex, and the fabric unbalanced, so the designs will show to best advantage if the following points are kept in mind.

1. Use colors that contrast well, but be careful that they don't set up a visual vibration; the pattern itself will be enough for the eye to deal with. Complementary colors—those opposite each other on the color wheel—usually will vibrate, particularly if both are strong in value.

2. Plain, even-textured yarns make smooth, compact stitches. Avoid fuzzy, nubby or irregularly twisted yarns because they will further complicate the pattern.

3. Knit two identical rows in the same color for each pattern row to keep the horizontal stripes in proportion to the vertical stripes. Some of the Brother/Knitking and Singer/Studio cards are punched with two identical rows, so can be used with the regular (ER) rotation setting; others have only one punched row for each pattern row, so should be used with intermittent (EOR) rotation.

4. Patterns from Group 1 can be knitted single or double bed using either the tuck or slip cam setting. Patterns from Group 2 can be knitted single bed with the slip setting only, or double bed with either the slip or tuck cam setting.

5. A double bed set-up is particularly suitable for Group 2 patterns, because it will stabilize the fabric and prevent unruly floats. Choose a backing which requires no needle selection so the face of the fabric will be flat and smooth. Our choice is modified weft (described in the Jacquard chapter), because its reduced number of rows works well with the face. Striper backing is also a possibility, though the reverse of the fabric will tend to form ripples.

6. Choose a stitch size which will make fabric that is firm and compact, but not too tight. The idea is to make the face as smooth as possible, with no gapping between the stitches.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Single Bed Group I pattern slip or tuck st RC2 ea col	Type A1 GX / BX ← Deco 2 or GX / AX ← Deco 2	Type A1 - EOR, neg rev o or ⌒ claw	Type A2 - EOR part ↔ or tuck ↔	Type A2 - EOR △ slip △ or △ tuck △
Single Bed Group 2 pattern slip st only RC2 ea col	Type A GX / BX ← or o Deco 2	Type A - EOR, pos or neg rev o claw	Type A - EOR part ↔	Type A - EOR △ slip △
Double Bed Group 1 pattern slip or tuck st with modified weft or striper backing RC2 ea col	Type A1 CX or N / AX ← or BX ← Deco 2	Type A1 - EOR, neg rev o or ⌒ / ↻ or ∧ claw	Type A2 - EOR part ↔ or tuck ↔ / part N or N N	Type A2 - EOR △ slip △ or △ tuck △ / o ← 1 or 1 1
Double Bed Group 2 pattern slip st with modified weft or striper backing or tuck st with striper backing RC2 ea col	Type A CX or N / BX ← or o Deco 2 or N / AX ← or o Deco 2	Type A - EOR pos or neg rev o / ↻ or ∧ or ⌒ / ∧ claw	Type A - EOR part ↔ / part N or N N or tuck ↔ / N N	Type A - EOR △ slip △ / o ← 1 or 1 1 or △ tuck △ / 1 1

EXPERIMENTING WITH COLOR: THEME AND VARIATIONS

It is both the color sequences and the number of colors used that produce the unexpected in mosaic patterning. As we said before, gazing at a punchcard, or even at a two-color mosaic swatch knitted with it, won't indicate what will happen when you start to experiment with two, three or four colors in different rows and sequences. It would take a computer to keep track of the number of mosaic patterns that might emerge from just one jacquard pattern.

Obviously, this can induce lunacy in the knitter in short order, so it is best to devise a method of approach before experimenting with color changes and sequences. Our method is to choose a jacquard pattern and knit a nice long sampler in sections of color sequences, with each color change within the sequence carefully noted.

The worst thing that can happen in three- or four-color work is that the design will become so fragmented it is no longer a mosaic. This can result in an attractive all-over multi-colored pattern. But if you want to stick to mosaics, some jacquard patterns work better than others. Patterns from Group 2, because adjacent needles slip or tuck, can be more exciting than Group 1 patterns. The following notes will help you with your own designing.

KNITTING A SAMPLER

The "parent" designs for the illustrated swatches are jacquard Patterns 2 and 3. The swatches are knitted three repeats wide and three tall. You can knit your sampler either single bed (with a Group 1 pattern such as jacquard Pattern 2) or double bed (with a Group 2 pattern such as jacquard Pattern 3). Set the main bed cam to slip rather than tuck; it will make a smaller fabric, use less yarn and is easier to knit. Set up enough needles for at least two complete horizontal repeats. Plan to knit at least two vertical repeats for each section, and separate the sections with two or more rows of plain knitting. It is most important to keep a record. List the punchcard number, cam setting, stitch size, yarn, and the color sequence. Attach your record to the appropriate section of the sampler.

Following are some color sequences you might try. You can add to these ad infinitum.

Suggested Color Sequences For The Sampler

1. Color changes every 2 rows. The card rotation setting depends on how the card is punched—whether it has one punched row (set EOR) or two identically punched rows (set ER).

RC2 col 1, RC2 col 2. This produces the usual two-color mosaic with either Group 1 or Group 2 patterns, and is a good reference point from which to start a sampler.

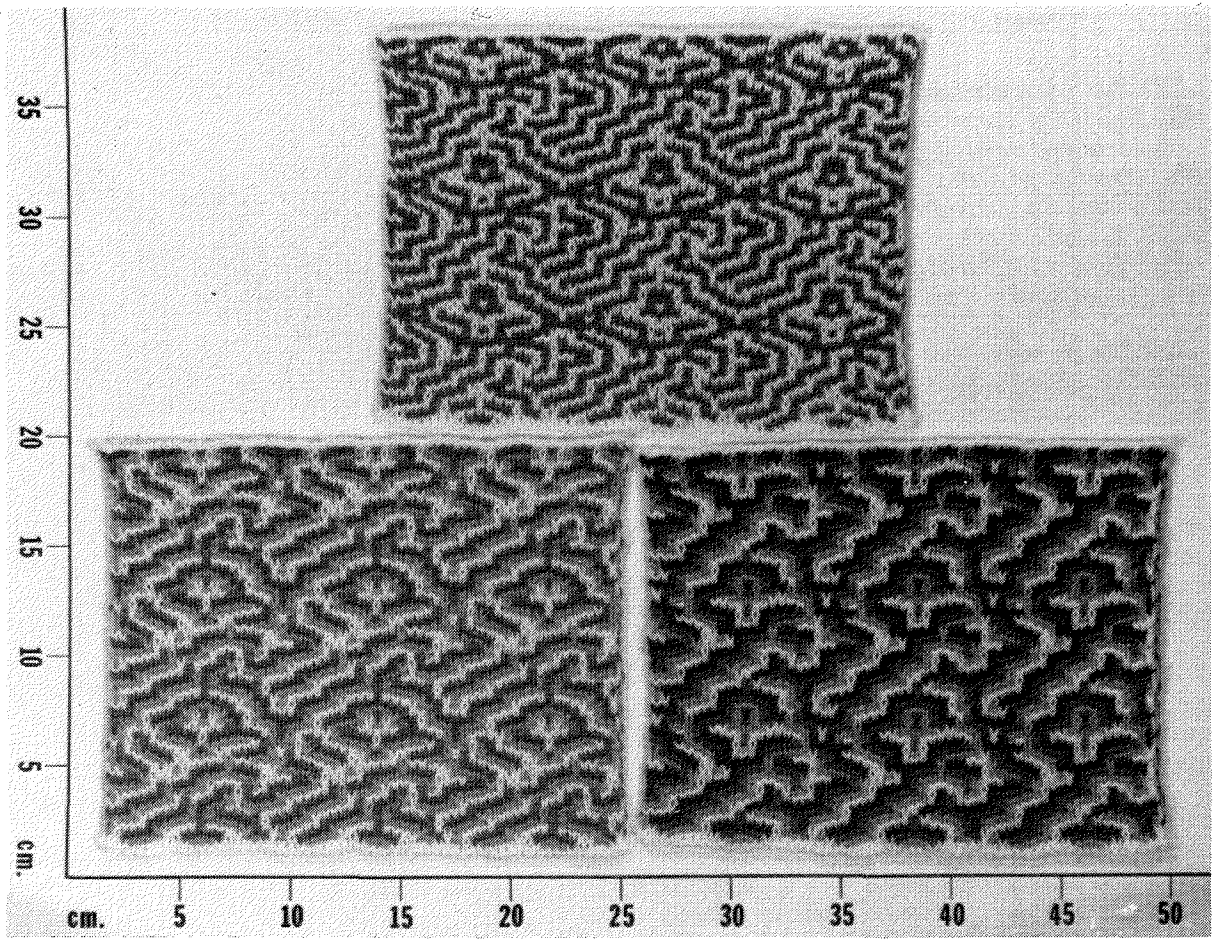
RC2 col 1, RC2 col 2, RC2 col 3, (RC2 col 4). Often the color repeat does not match the punchcard repeat, which means you must knit more than two repeats to get one complete color repeat.

RC2 col 1, RC2 col 2, RC2 col 1, RC2 col 3, (RC2 col 1, RC2 col 4). This sequence works well with both Group 1 and Group 2 patterns, and will produce a mosaic pattern on a horizontally striped background or horizontally striped mosaic on a plain background. Or, you can make different colored solid backgrounds for selected areas of the repeat.

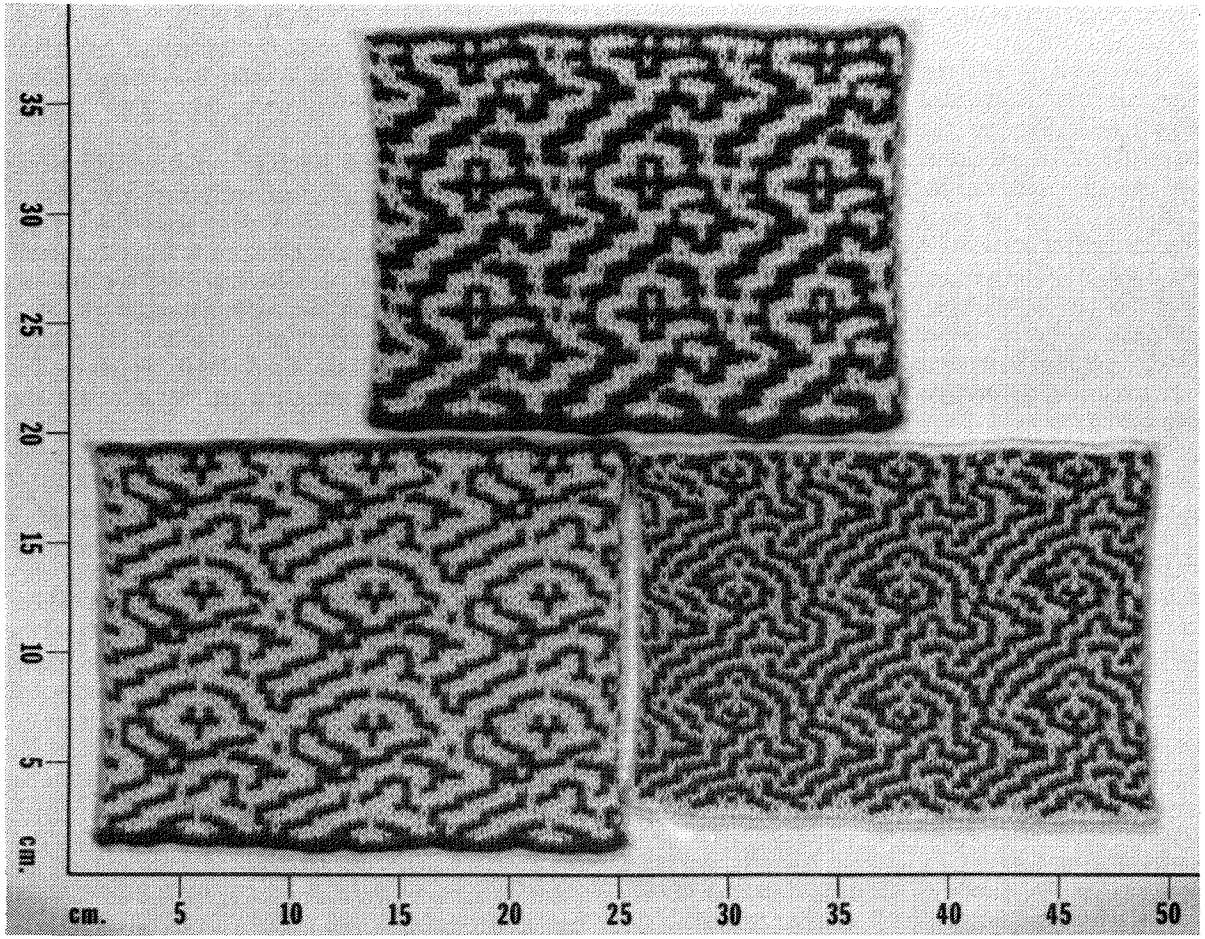
2. Card rotation is the same as for 1 above, but more than one pattern row is knitted with the same color.

RC4 col 1, RC4 col 2, (RC4 col 3, RC4 col 4). The resulting mosaic will be a simplified version of the original mosaic pattern and double in size. Group 2 patterns are best, as Group 1 patterns produce mostly horizontal bands.

RC2 col 1, RC4 col 2, (RC2 col 1, RC4 col 3, RC2 col 1, RC4 col 4). This sequence also simplifies the design and works best with Group 2 patterns. In both sequences, starting the card on the second pattern row rather than the first will make a different design.



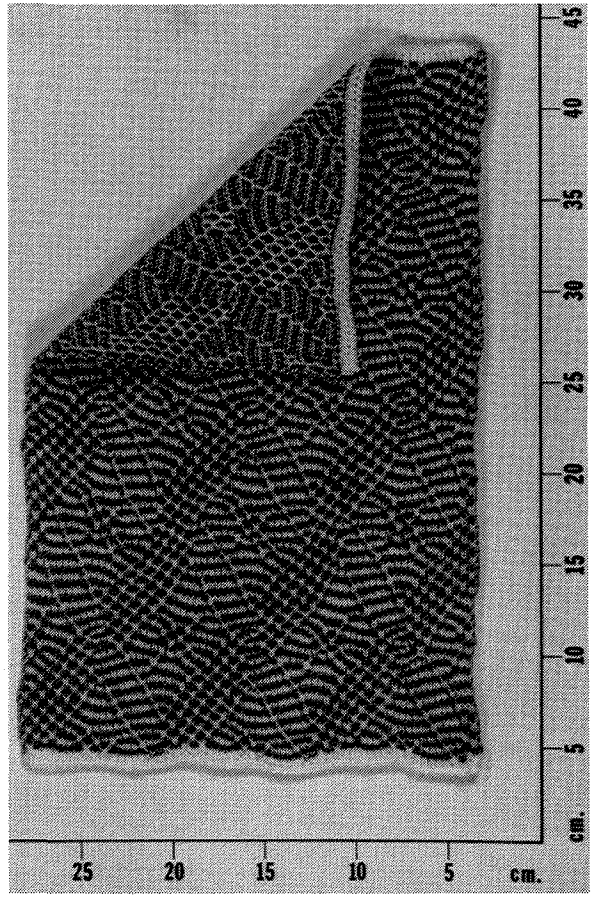
Sampler variations. Group 2 mosaic pattern (jacquard Pattern 3), knitted double bed in slip stitch with modified weft backing.
Top: 2 rows col 1 (light), 2 rows col 2 (dark).
Bottom left: 2 rows each, col 1, col 2, and col 3 (light to dark).
Bottom right: 2 rows each, col 1, col 2, col 3, col 4 (light to dark).



More sampler variations using jacquard Pattern 3.
Top: 4 rows col 1 (light), 4 rows col 2 (dark). Two pattern rows each color.
Bottom left: 2 rows col 2 (dark), 4 rows col 1 (light). One pattern row in dark color, 2 pattern rows in light color.
Bottom right: needle selection has been reversed throughout the pattern from that of the 5 swatches shown above, by using an arrow key or reverser.
Knitted with 2 rows col 1 (light), 2 rows col 2 (dark).

3. The pattern row changes every 4 rows instead of every 2 rows. The card rotation setting depends on how the card is punched, as in 1 above (it may be necessary to stop the card).

RC2 col 1, RC2 col 2. This will be a new pattern, which results from knitting at least two colors with the same needle selection. The elongated card rotation causes the pattern to expand vertically; the more colors used, the greater the expansion. The design will still be mosaic, but will more closely resemble the design on the card. Also, the fabric will be more unbalanced, which will give it an interesting relief quality. It is best to use a Group 1 pattern, knitted single bed with tuck stitch.



Group 1 mosaic pattern (jacquard Pattern 2), knitted single bed in tuck stitch with 2 rows col 1, 2 rows col 2, with same needle selection for all 4 rows.

A few more mosaic effects to try

Change the order of the colors. Darker or stronger colors tend to stand out in the design. A different part of the mosaic becomes dominant when the colors exchange places in the sequence.

Stop the card and knit one or two colors with more rows at the same selection, then one or two colors at the usual rotation. This will cause certain portions of the design to expand, while others do not.

Reverse the needles which knit and slip if you're using a Group 2 pattern. On Passap, use the left arrow key; on Superba, change the reverser; for the Japanese machines, you must punch another card.

DESIGNING YOUR OWN MOSAICS

Experimenting with the punchcards supplied with your machine or provided in this book can produce more mosaic patterns than you may ever have the desire to knit, but designing patterns from scratch can give you a personal satisfaction.

You can, of course, design a jacquard pattern, make a punchcard for it, then see what will happen when you use it for mosaic knitting. But if you prefer to *know* what the mosaic will look like before you knit it, you can chart a mosaic pattern on graph paper. Then punch a card for it, and you'll not only have a mosaic card, but a new jacquard pattern and a one-color slip or tuck pattern as well!

Use graph paper to plot your design. Paper with ten squares per inch is practical to work with. You'll need a good pencil—and a large eraser.

Design suggestions are everywhere: in nature there are flower, leaf and shell forms; even household items and industrial materials can give you ideas. Some of the very best sources of inspiration are traditional embroidery and pottery. Look at designs from the Chinese, Japanese, Celtic, Arabic, Eastern European and Greek cultures, and those from the American Indians. Some of the popular paperback puzzle and maze books have designs that adapt easily to knitting mosaics. If you are convinced you don't have a creative notion in your head, locate one of Barbara Walker's books, *Mosaic Knitting* or *Charted Knitting Designs.* They contain hundreds of charted mosaic designs, most of which are suitable for Group 1 patterns.

Drawing the pattern on the graph is really quite simple. There are just two major points to remember. First, all the verticals and horizontals in both the positive parts of the design (the darkened squares) and the negative areas (the white squares) should be no more than two squares wide—one square is preferable—for verticals, or one square tall for horizontals. Second, a horizontal line of adjacent darkened squares must be coupled with single (or double) white squares on one pattern row, and vice versa on the next pattern row. Maintain this alternation throughout the repeat. The repeat will then have an even number of pattern rows. Groups of adjacent darkened squares and adjacent white squares must not occur on the same pattern row. Following is the procedure.

Let each square on the graph paper represent one stitch and two knitted rows. On the bottom half of the paper, draw outlines for at least two repeats of the pattern in both length and width, four repeats altogether.

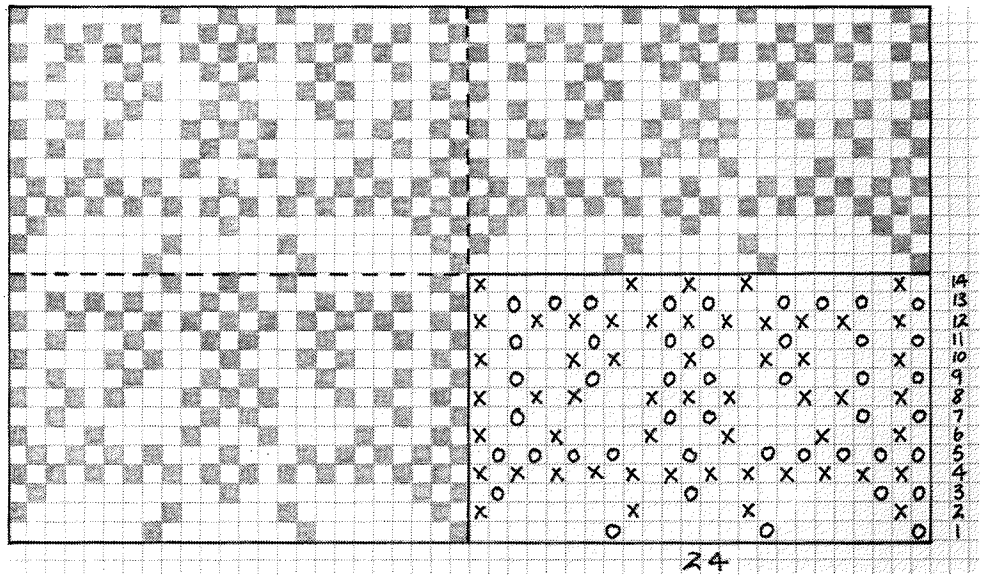
Fill in each repeat. Keep in mind the two points above. Filling in all four repeats allows you to spot errors and make design adjustments where the repeats join. Now you have a drawing of what your mosaic pattern will look like when knitted. You are ready to draw the graph pattern for the punchcard.

Use a different colored pencil to draw an outline around one repeat, then number each row as shown. On the top part of the graph paper, draw an outline the same number of stitches wide as your mosaic pattern, and with the same number of pattern rows. Number the stitches across the bottom of the repeat; it helps keep your place when making the punchcard graph.

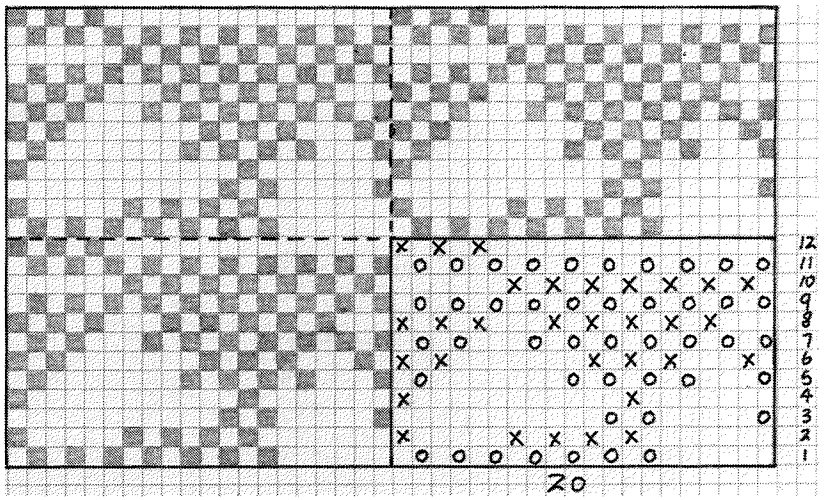
Now fill in the squares for the punchcard graph. On all odd-numbered rows, mark a circle in the corresponding square on the punchcard graph where there is a *single* stitch indicated in black (or white) on the mosaic design; on all even-numbered rows, mark an X in the corresponding square on the punchcard graph where there is a *single* white (or black) square on the mosaic design. Mark only the single squares for each pattern row; they will alternate black and white on successive pattern rows.

Now you can see what both the jacquard design and the mosaic pattern will look like, and understand the relationship between the two. Changes or corrections can be made at this stage. Check particularly that there are no vertically or horizontally *adjacent* squares marked on the punchcard graph.

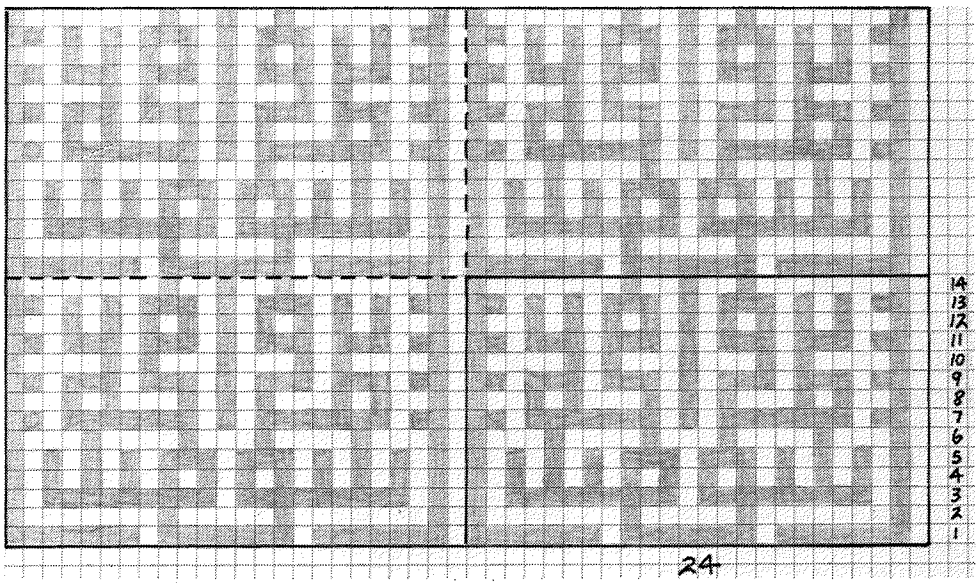
Following the punchcard graph, mark your card and punch it. For Passap and Superba, punch out the marked squares. For Brother/Knitking and Singer/Studio, punch out the unmarked squares, either one row tall, for EOR rotation; or two rows tall, for ER rotation.



Punchcard diagram. Punch white squares.

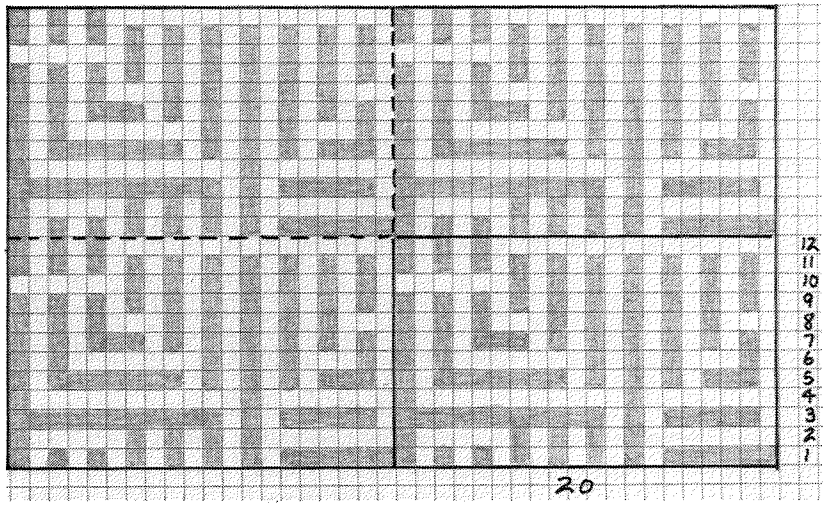


Punchcard diagram. Punch dark squares.



Mosaic design.

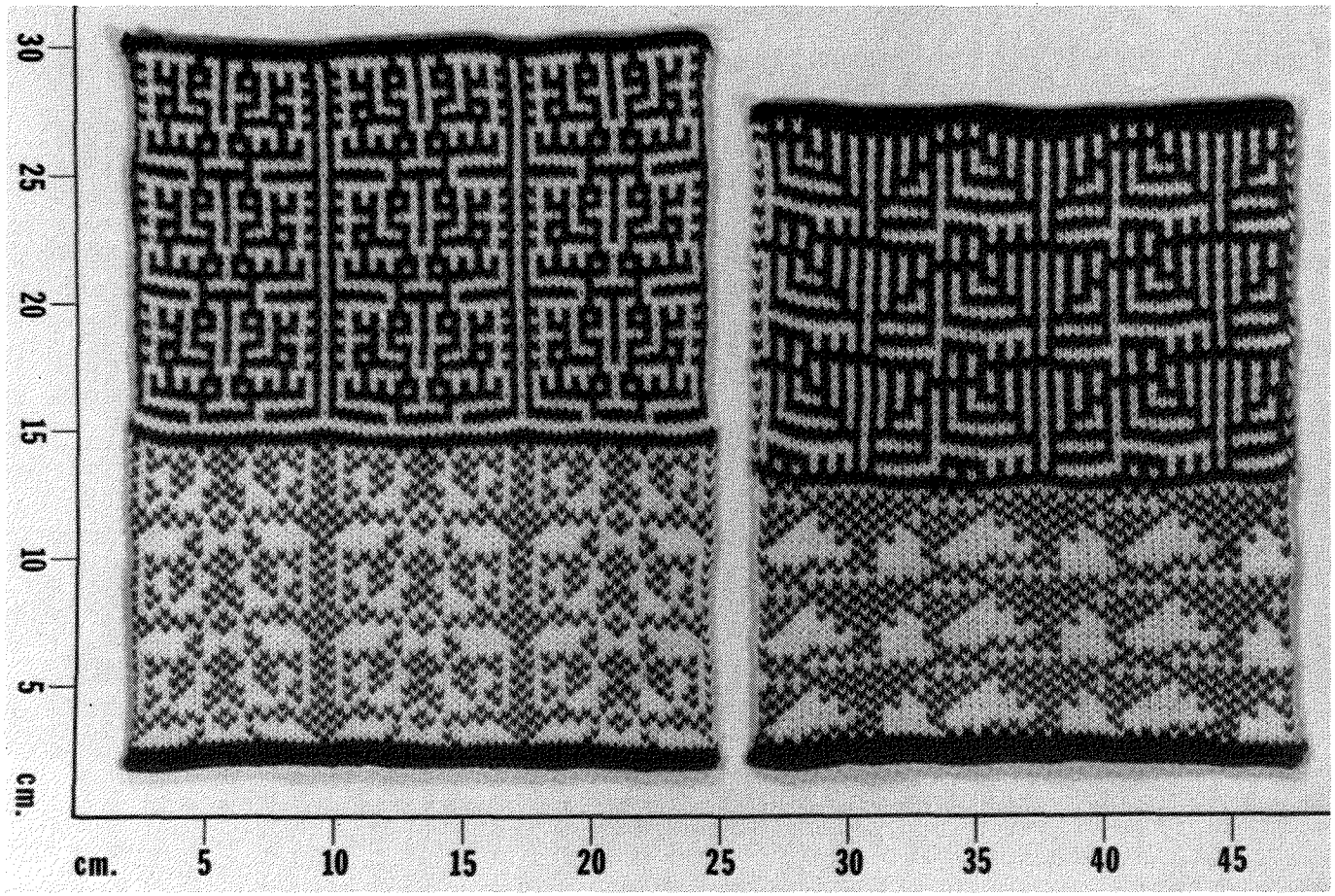
For Japanese machines.



Mosaic design.

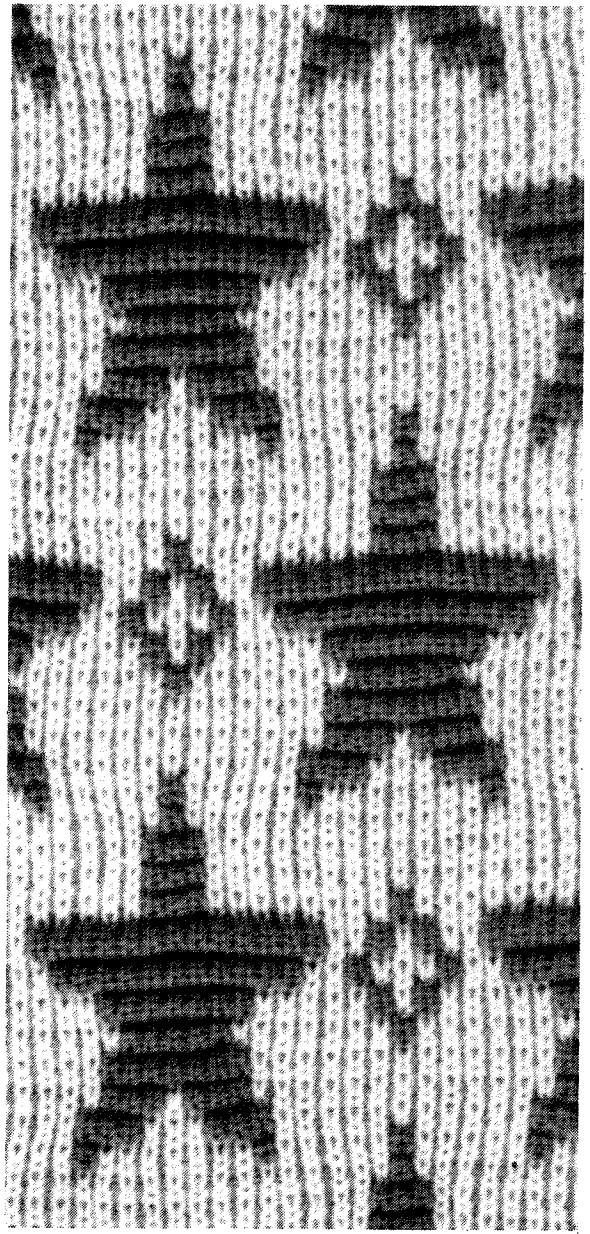
For European machines.

Designing your own mosaics: designs for Group 1 patterns.



Design your own mosaic. Bottom parts knitted in jersey jacquard, top parts in single bed mosaic with slip stitch cam setting.
Left: for Japanese machines, 24-stitch repeat with mosaic knitted as graphed. Col 1, dark; col 2, light.
Right: for European machines, mosaic knitted as graphed but with colors reversed. Col 1, light; col 2, dark.

CHAPTER 3
Ripple Fabrics



In this chapter we proceed from flat jacquard knitting into the hilly textures of rippled fabrics, those with pin tucks and nopps. Rippled fabrics, or relief fabrics, are made on double bed machines and are characterized by a series of raised bulges, or ripples, on either the face or reverse of the fabric. The ripples are created by knitting a very unbalanced fabric; that is, by knitting more rows on one bed than on the other. Ripples occur on the surface having the greatest number of rows.

An individual ripple can be made two ways. A horizontal roll called a *pin tuck* is made by knitting on one bed and slipping on the other for about 6 to 10 rows, followed by plain knitting on both beds together. A horizontal row of clusters, known as *nopps* (sometimes *knopps* or *nopes)* is made by knitting on one bed and tucking on the other for about 4 to 8 rows, followed by plain knitting on both beds together. Both fabrics can be knitted without needle selection as an all-over surface texture. Punchcards may also be used, to create a pattern in the texture. Both fabrics use the same punchcards and the same basic techniques. Usually pin tucks and nopps are seen knitted in one color as a textured pattern, but two colors can be used very effectively in a number of different techniques.

Pin tuck and nopp fabrics share some of the characteristics of tuck or slip stitch fabrics. The pin tuck fabric is usually firmer, with reduced stretch across the width; the nopp fabric is quite a bit looser, with more stretch across the width.

TECHNIQUES FOR KNITTING RIPPLE FABRICS

1. Use a plain, smooth, fairly fine yarn in order to highlight the texture of the rippled surface.
2. The size of the ripple depends on the number of rows that can be knitted on the ripple bed before the stitches begin to ride up and off the needles. This varies with the machine and type of yarn. Generally, on Passap and Superba more rows can be knitted because the strippers or pushing-down wheels will push the stitches down from above, while the weights pull from below. For Brother/Knitking and Singer/Studio machines, try using a long, thin rod (such as the needle retaining rod from another machine) or a long, thin knitting needle inserted between the beds at the start of a pin tuck, or midway through a nopp, and weighted at each end. (The six-row pin tuck and four-row nopp illustrated presented no problems on any machine.)
3. To help produce a higher or more pronounced ripple, make the stitch size on the ripple bed one or two numbers higher than on the backing bed.
4. Use extra weights, especially with nopp fabrics. The stitch size for nopps must be carefully adjusted so that all stitches and loops knit off properly on the full needle rib rows.
5. In pattern work, simple, bold patterns are easier to knit and will be more clearly defined than will intricate ones.
6. Plan the design so that about the same number of needles forms the pattern on successive pattern rows. This will prevent distortion of the selvedges. For instance, if you use ten needles to make nopps on one pattern row but only three needles on the next, the fabric will be pulled in at that point and the selvedges will be uneven.
7. After knitting a pin tuck fabric, insert a knitting needle through each pin tuck to shape the "roll."

SIMPLE ALL-OVER PATTERNS WITH PIN TUCKS AND NOPPS

The same basic procedure is used to knit ripple fabric with either pin tucks or nopps. The main difference between the two is in the cam settings. The photos below show ripples knitted with increasing numbers of rows in each set of four ripples. You should determine the number of rows most suitable for your machine and yarn, and use this number when knitting all the ripple fabrics, regardless of the number of rows shown in the swatches illustrated here. These swatches are knitted in two colors to accentuate their structures, but ripple fabrics can be just as effective in one color.

Basic Pin Tucks

Pin tucks are formed across the entire width of the fabric. No punchcard or needle selection is required.
1. Knit one or two rows of FNR, SS fairly tight.
2. Knit several rows in stockinette (4 to 10, depending on machine and on yarn thickness), *on one bed only.* Increase the SS on this bed to one suitable for stockinette. Pin tucks will form on the bed which knits the stockinette rows.

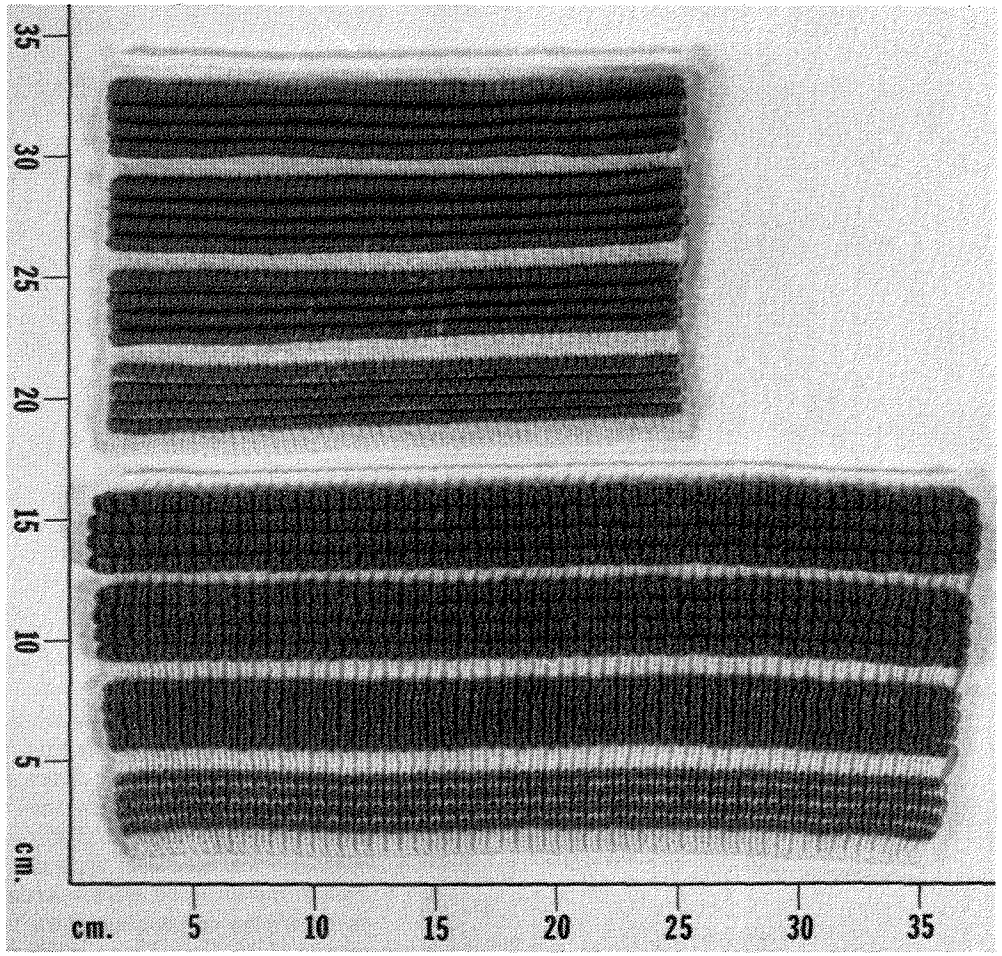
3. Knit one or two rows of FNR to lock the pin tuck in place and form the backing; SS as in step 1.
4. Repeat steps 2 and 3.

Basic Nopps

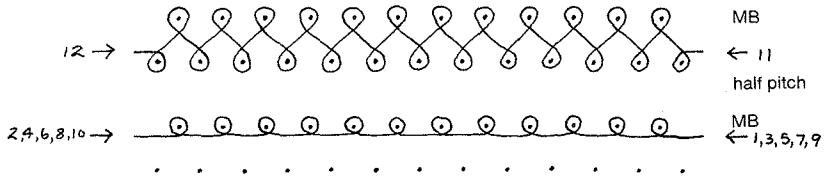
Nopps are formed across the entire width of the fabric. No punchcard or needle selection is required.

1. Knit one or two rows of FNR, SS fairly tight.
2. Knit several rows (2 to 8, depending on machine and on yarn thickness) with one bed tucking all needles; the opposite bed knitting all needles plain. Nopps will form on the bed that knits.
3. Knit one or two rows of FNR to knit off tuck loops and lock nopps in place.
4. Repeat steps 2 and 3.

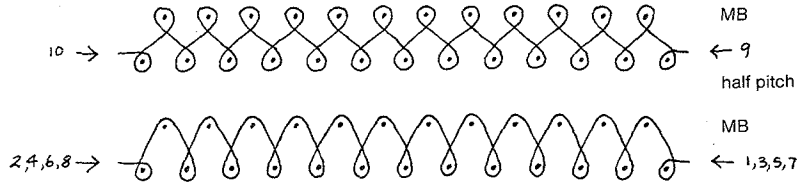
	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Basic pin tucks	RC 1-2 N / N ; RC 3-10 GX / N or N / GX	RC 1-2 Λ / Λ ; RC 3-10 o / Λ or Λ / o	RC 1-2 plain / N N ; RC 3-10 part ↔ / N or plain / part ↔	RC 1-2 o stock o / 1 ← 1 ; RC 3-10 o slip o / 1 ← 1 or o stock o / o ← o
Basic nopps	RC 1-2 N / N ; RC 3-8 AX / N or N / AX no pushers	RC 1-2 Λ / Λ ; RC 3-8 ⌒ / Λ or Λ / ⌒	RC 1-2 plain / N N ; RC 3-8 tuck ↔ / N or plain / tuck ↔	RC 1-2 o stock o / 1 ∩ 1 ; RC 3-8 o tuck o / 1 ∩ 1 or o stock o / o ∩ o



Basic pin tucks and nopps knitted on one side of fabric only.
Top. Pin tucks. Each group knitted with 4 (6, 8, 10) rows of stockinette for each pin tuck.
Bottom. Nopps. Each group knitted with 2 (4, 6, 8) rows of tuck loops for each row of nopps.



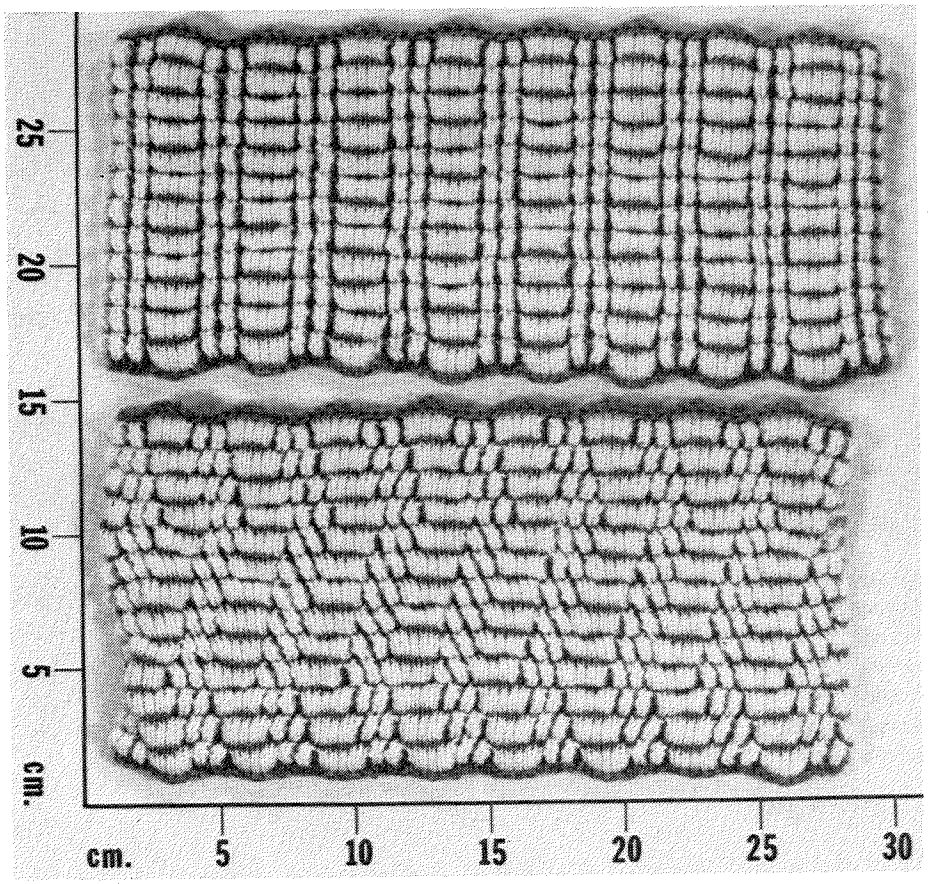
Basic pin tuck. Extra needle on backing.



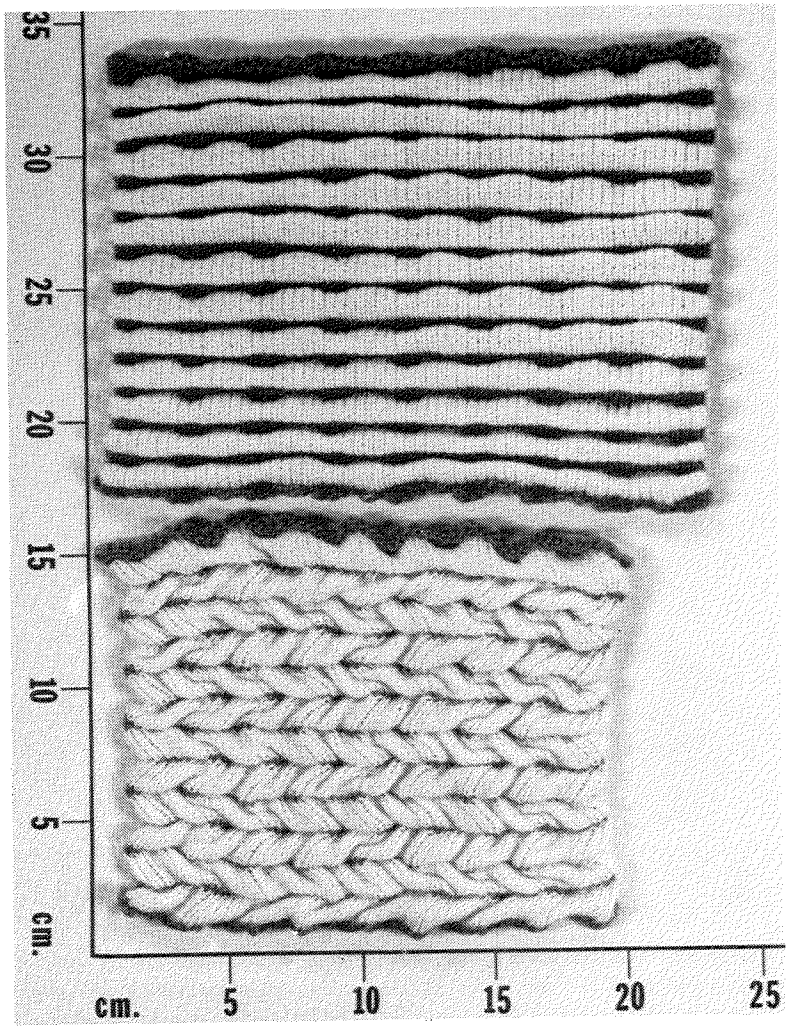
Basic nopps. Extra needle on backing.

Patterning By Leaving Needles Out of Work

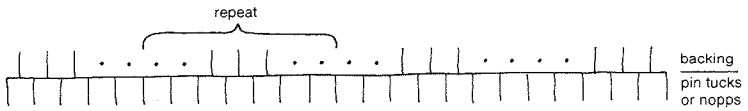
Interesting changes in these basic fabrics can occur when you combine racking with leaving out needles on the backing bed. Four such variations, all made with the same needle set-up, are shown in the swatches below. Changes in the needle set-up on both ends, the number of needles racked, and the racking sequence can produce some very intriguing patterns.



Top. Knit as basic nopps, with two rows FNR between nopps.
Bottom. Set up and cast on as shown. Racking occurs after the first row of FNR between nopps, by one needle either L or R, then knit second row of FNR, and proceed with the next row of nopps.



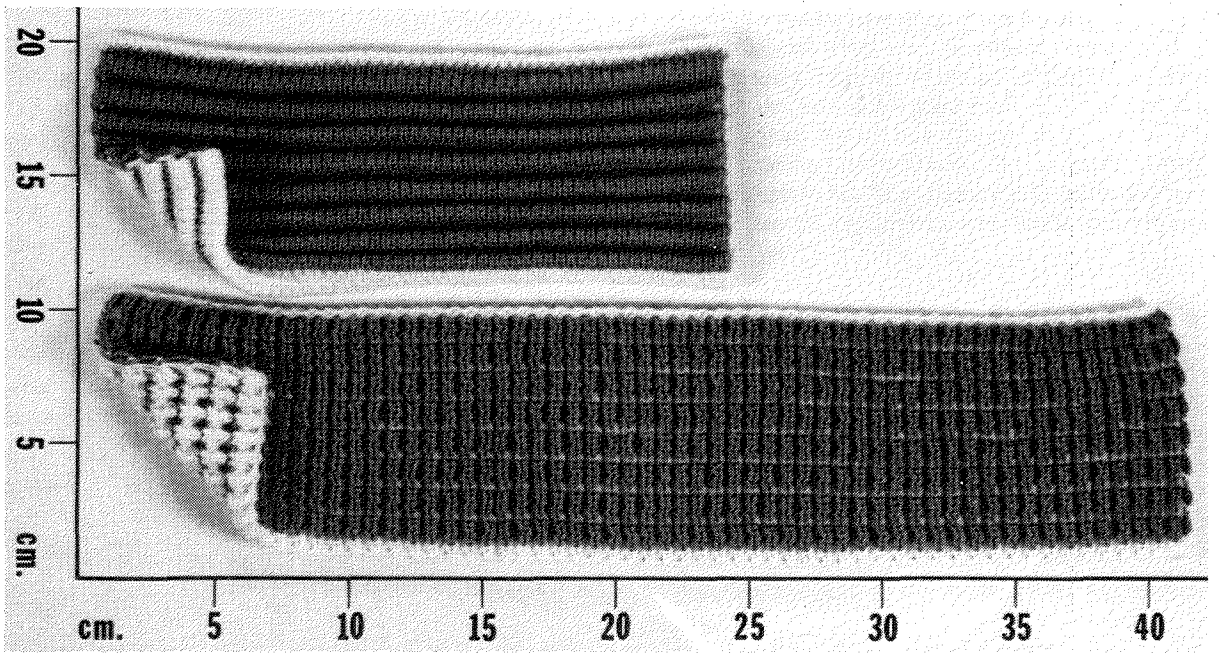
Top. Knit as basic pin tuck, with 2 rows FNR between pin tucks.
Bottom. Set up ndls with racking position centered, then rack 3 ndls L (or R) before casting on. After knitting each pin tuck, rack 6 ndls R (or L) before knitting 2 rows of FNR.



Basic pin tucks and nopps with patterning created by leaving groups of needles in NWP on one bed, coupled with racking.

Reversible Ripples

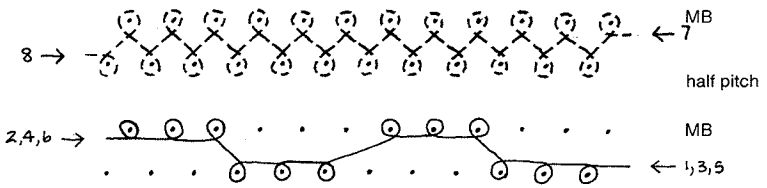
A reversible fabric can be made with ripples on both sides. On alternate ripples, simply reverse the bed which makes the ripple.



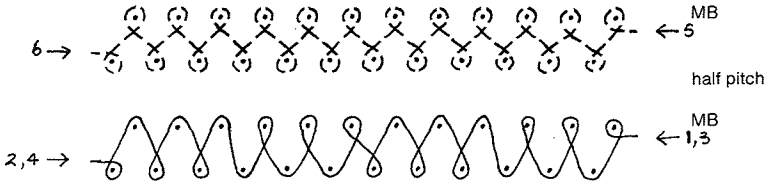
Reversible pin tucks and nopps. Color 1 is used when the main bed knits the ripple, color 2 when the second bed knits the ripple. Ripples are knitted with an odd number of rows, with only one row FNR between.
Top. Reversible pin tucks.
Bottom. Reversible nopps.

Reversible Checks in Ripple

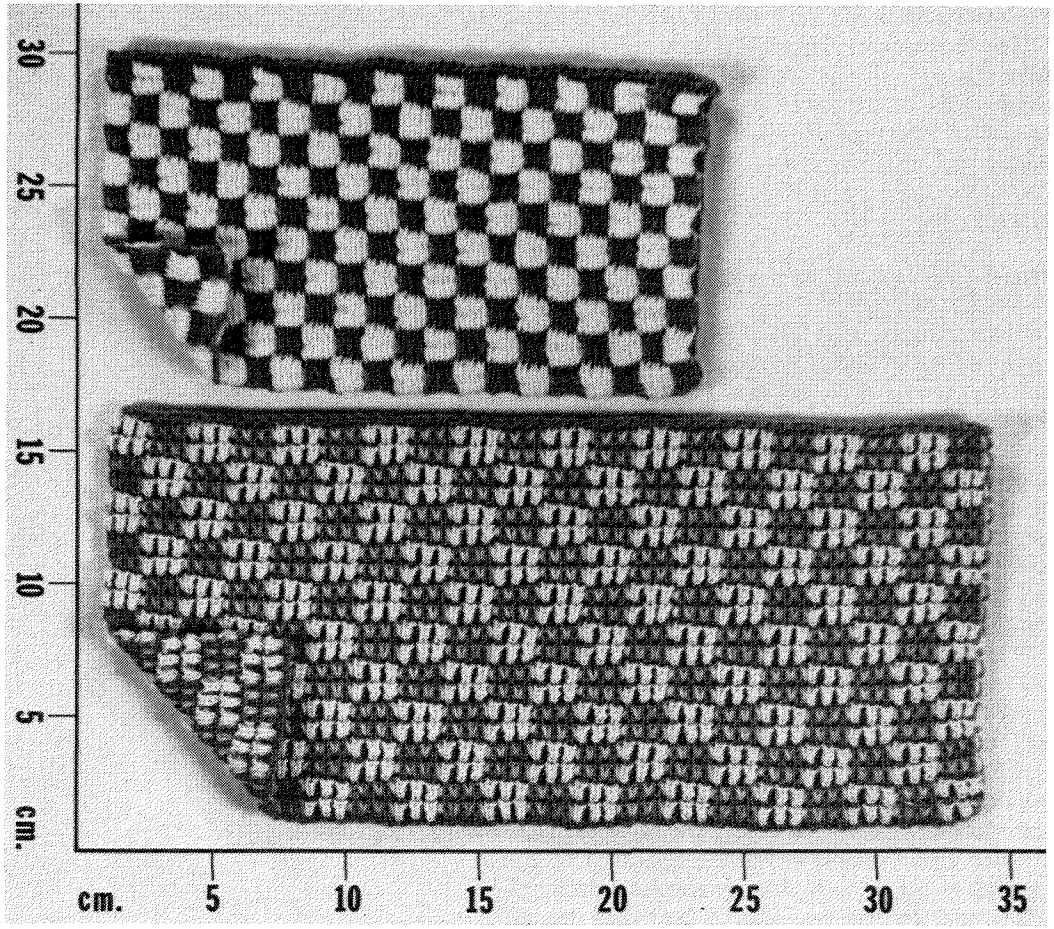
A variation of reversible ripple fabric is a checkered pattern. It requires a 3x3 needle selection on both beds, which alternates on successive checks. On all machines except Passap, a 3x3 punchcard locked on a row can provide the selection for the main bed, while a pattern ruler must be used for the second bed. On Passap, set up pushers in a 3x3 division on both beds, which is WP/RP on one bed, and RP/WP on the other. The stitch formation diagram illustrates how the checks are knitted.



Reversible check in pin tuck.



Reversible check in nopps.



Reversible checks. Needle set-up is FNR. Alternating groups of 3 ndls on both beds are continually selected and knitted in col 1 (light). Both carriages must be set for either slip or tuck. When enough rows have been knitted for the rippled checks, change to col 2 (dark) and knit 2 rows across all ndls. The next row of checks is knitted with the alternate ndl selection. SS is the same for both beds.
Top. Reversible check in pin tuck. Needle selection alternates each row of checks.
Bottom. Reversible check in nopps. Needle selection is the same for 2 rows of nopps (to make a "square" check), then reversed for the next 2 rows of nopps.

PUNCHCARD RIPPLE KNITTING

The Passap and Singer/Studio ribber books both have instructions for pin tuck punchcard patterns. Study the punchcards and the instructions so you'll understand how punch pin tuck patterns are planned. Although these two machines are the only ones to provide specific instructions, punch pin tuck can be knitted on all machines.

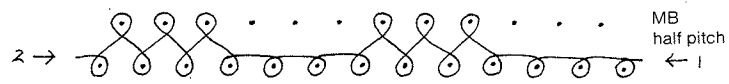
One-Color Relief Patterns

Set up for FNR on both beds. In punch pin tuck, the second bed (opposite the punchcard) knits plain stitches throughout. It is on this bed that the pin tuck will show, so the stitch size should be larger than on the main bed. The main bed—with the punchcard—will have needle selection for the pattern, with cams set for slip. Selected needles (determined by punched holes on the card) will knit plain; non-selected needles will slip. When the same needles are allowed to slip several rows in succession a ripple is produced in the fabric being knitted on the other bed, opposite the needles doing the slipping.

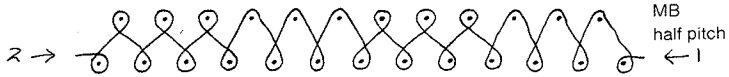
The same principle applies to nopps. Simply change the main bed cam to tuck instead of slip; nonselected needles will tuck several rows in succession and nopps will form on the opposite bed.

The punchcards used for this kind of ripple fabric are the same as those for mosaic knitting (described in the Mosaics chapter), and have the same limitations. In fact, the principle governing this kind of ripple knitting is the same as that for mosaic knitting. The differences are that one color is used here instead of two or more, and that striper backing instead of modified weft backing is used to produce the relief effect. A word of caution: before you design or use a card for punch nopps, be sure the needles tucking on successive rows do not tuck more than the yarn or the machine will tolerate, otherwise too many loops will accumulate on a needle and the carriage will jam.

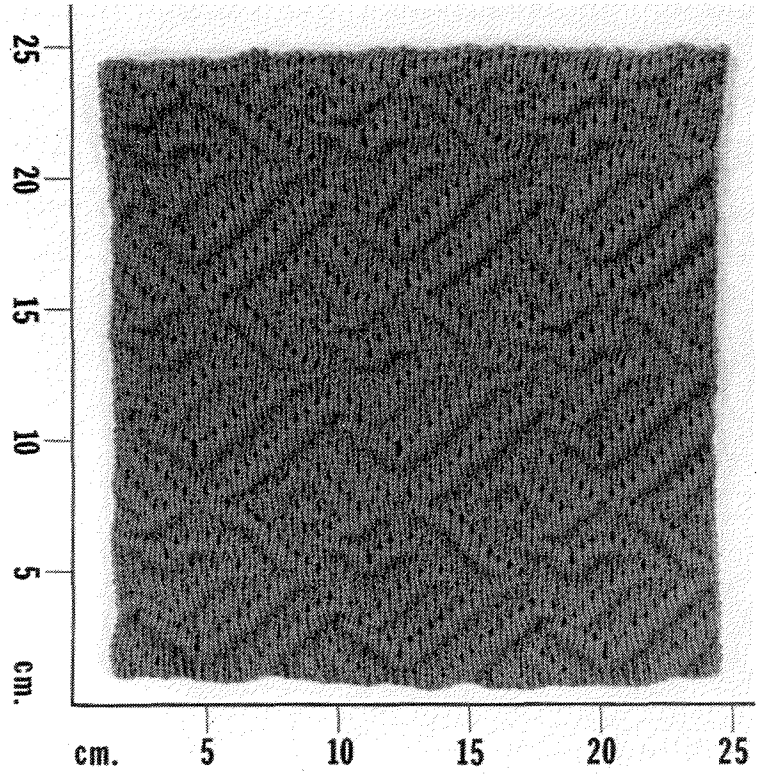
	Passap	carr R	Superba	carr R	Brother/Knitking	carr L	Singer/Studio	carr L
Punch pin tuck one color	N / BX ← or o Deco 2	Type A	o / ∧	Type A EOR pos or neg rev	part ↔ / N N	Type A EOR	△ slip △ / 1 1	Type A EOR
***Punch nopps* one color**	N / AX ← or o Deco 2	Type A	⌒ / ∧	Type A EOR pos or neg rev	tuck ↔ / N N	Type A EOR	△ tuck △ / 1 1	Type A EOR



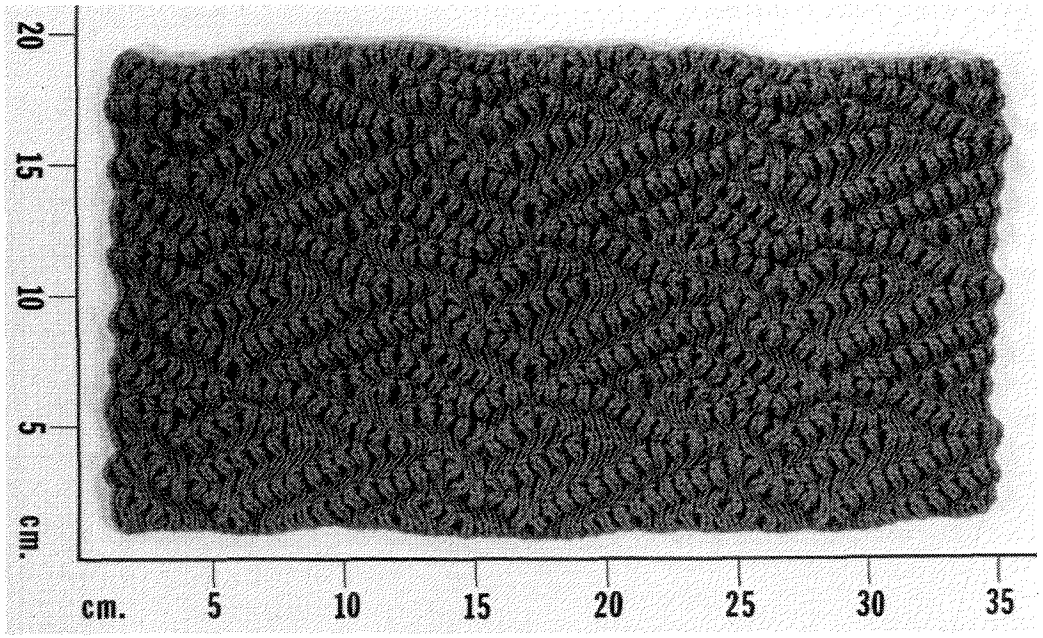
Punch pin tuck in one color. Extra needle on backing.



Punch nopps in one color. Extra needle on backing.



Punch pin tuck.



Punch nopps.

One-color punch pin tuck and punch nopps. Knitted with jacquard Pattern 3.

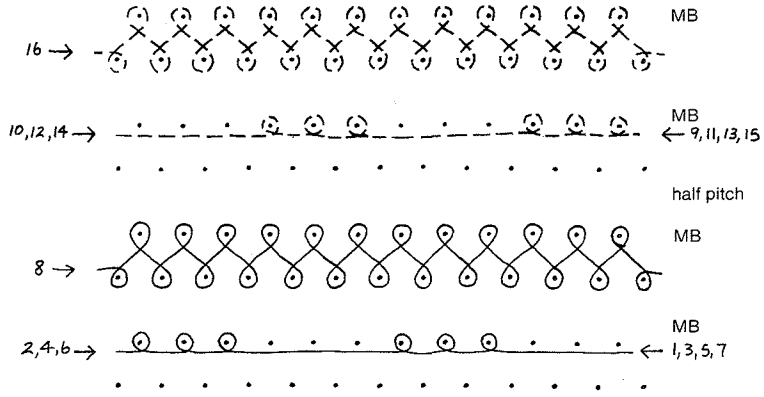
Two-Color Relief Patterns

Different principles are used to knit two-color pin tuck and nopps. First, a Type C-1 or C-2 jacquard punchcard is used on all machines except Superba, which uses a Type A card and reversers. Second, the pin tucks or nopps are knitted into both background and design to give an all-over ripple texture in both colors. Each color will knit with the same needle selection for several rows (which means either stopping the card or punching two rows the same, depending on the machine).

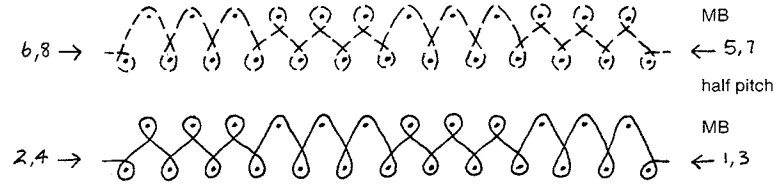
In pin tuck, the ripple will be formed on the *main bed*, and floats will occur across non-selected needles. These floats will be enclosed by the last row of each pin tuck, when both carriages are set for FNR, which also attaches the pin tuck to the backing. In other words, each pin tuck is knitted with an odd number of rows on one bed, then the cams are changed to knit, and the last even row is knitted across all the needles on both beds. The punchcard then proceeds to the next pattern row, which is knitted with the second color, following the same procedure.

Two-color nopps are formed on the *second bed*, rather than main bed as in pin tuck. As four-row nopps are easy for all machines, it is best to use a Type C-2 jacquard punchcard, with EOR rotation. Passap knitters can also use a Type C-1 jacquard punchcard with Deco set on 4. No cam changes are necessary while knitting nopps because the first row of the next selection, with the new color, will knit off the stitches of the previous group of nopps to form the backing.

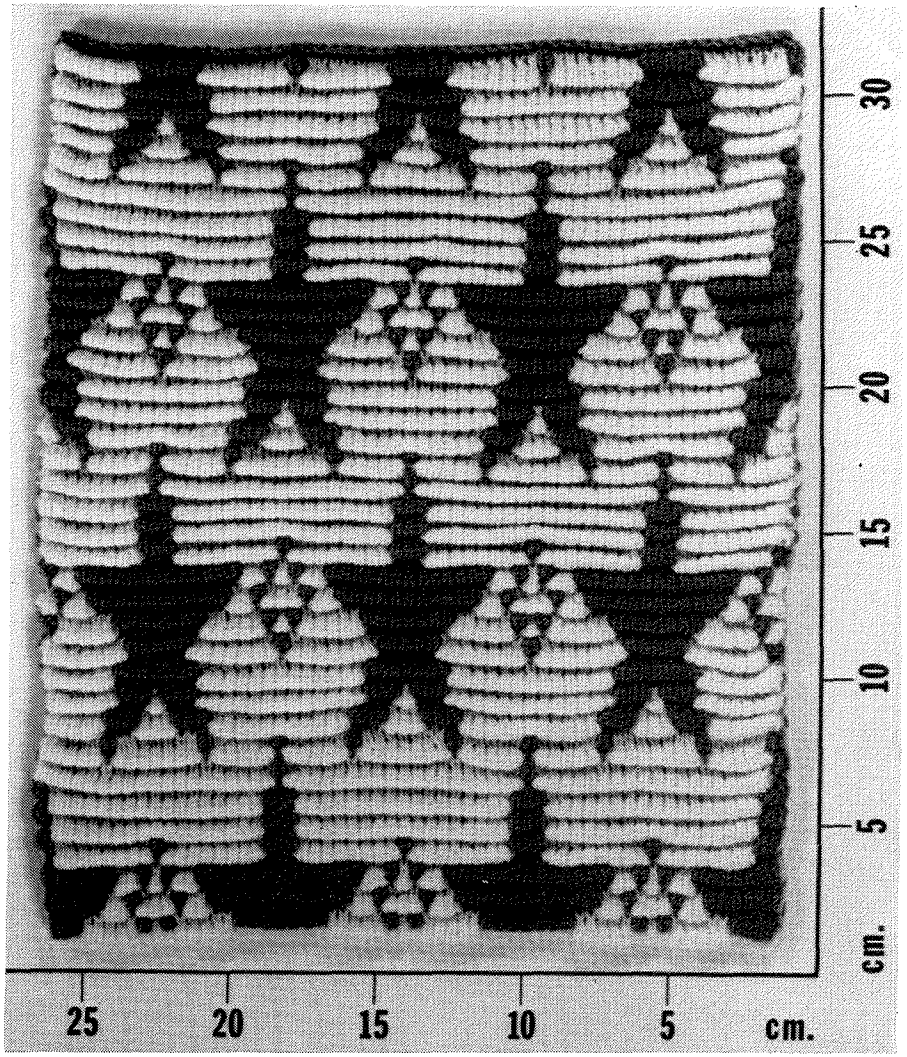
	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Punch pin tuck two colors	Type C2 col 1: RC 7 GX / BXo Deco 4; RC 1 N / N repeat with col 2 can use Type C1 with Deco 2, uncoupled	Type A stop card col 1, pos rev: RC 3-10 o / o ; RC 1 ∧ / ∧ repeat with col 2, neg rev then move to next patt row claw	Type C1 stop card col 1: RC 5-7 part ↔ / part ↔ ; RC 1 plain / N N move card to next punched row and repeat with col 2	Type C1 stop card col 1: RC 5-7 △ slip △ / o ← o ; RC 1 △ stock △ / 1 ← 1 move card to next punched row and repeat with col 2
Punch nopps two colors	Type C2 N / AXo Deco 2 or 4 RC 4 ea col - Deco 2 RC 8 ea col - Deco 4	Type A stop card ⌒ / ∧ RC 4 col 1 - pos rev; RC 4 col 2 - neg rev then move to next patt row claw	Type C2 EOR tuck ↔ / N N RC 4 each col	Type C2 EOR △ tuck △ / 1 1 RC 4 each col



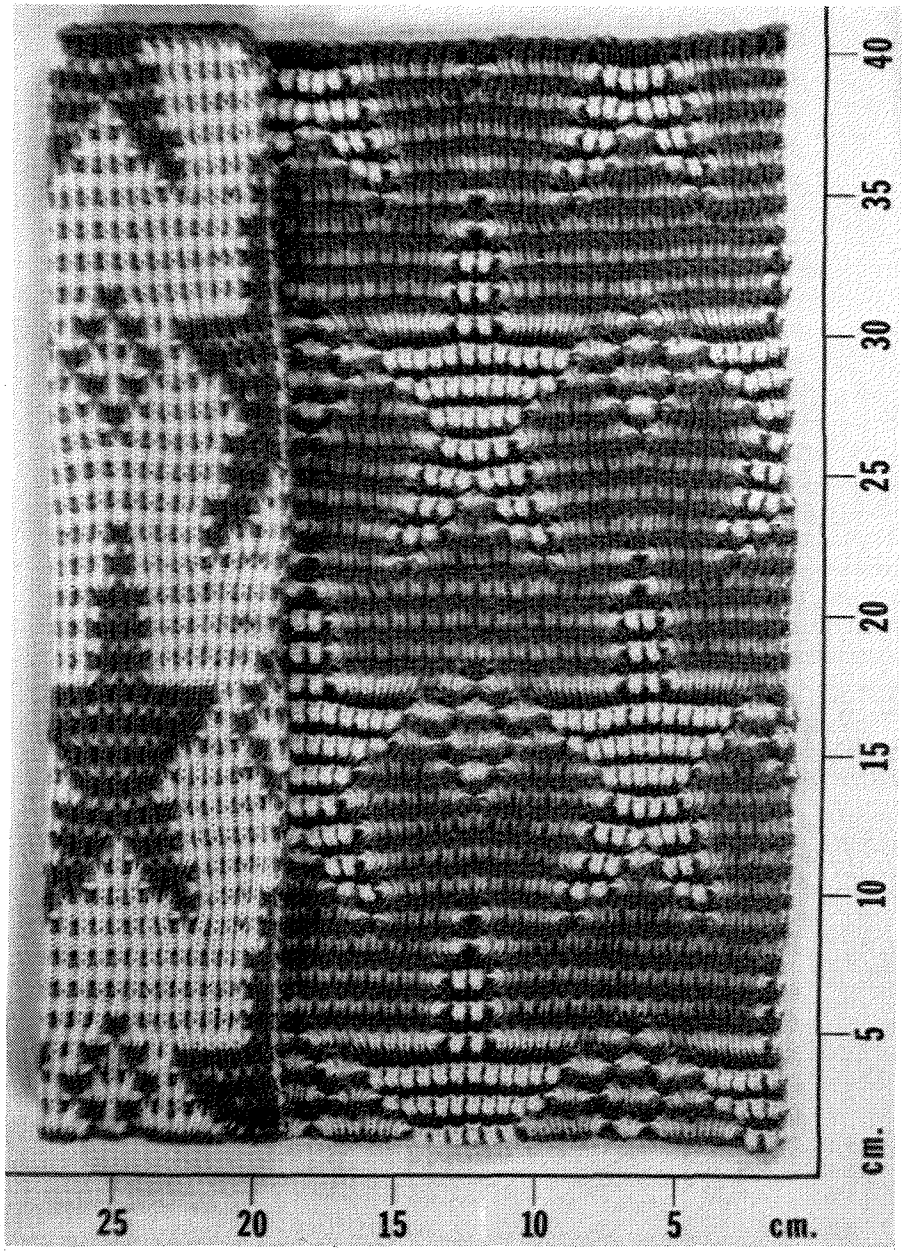
Punch pin tuck in two colors. Extra needle on backing.



Punch nopps in two colors. Extra needle on backing.



Punch pin tuck. Pin tucks are knitted on main bed.



Punch nopps. Nopps are knitted on second bed.

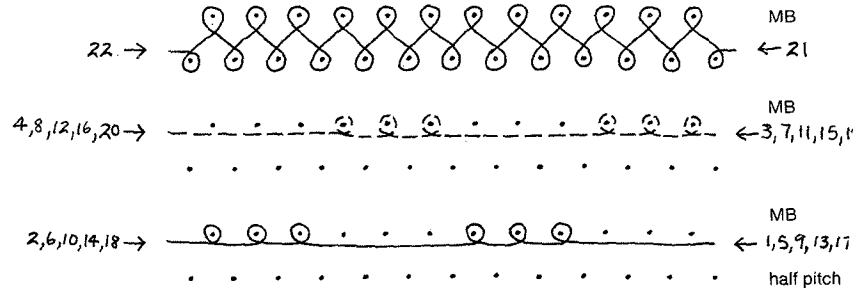
Two-color punch pin tucks and punch nopps. Both colors knit ripples. Design is jacquard Pattern 9.

BASIC PIN TUCKS KNITTED IN TWO-COLOR JACQUARD

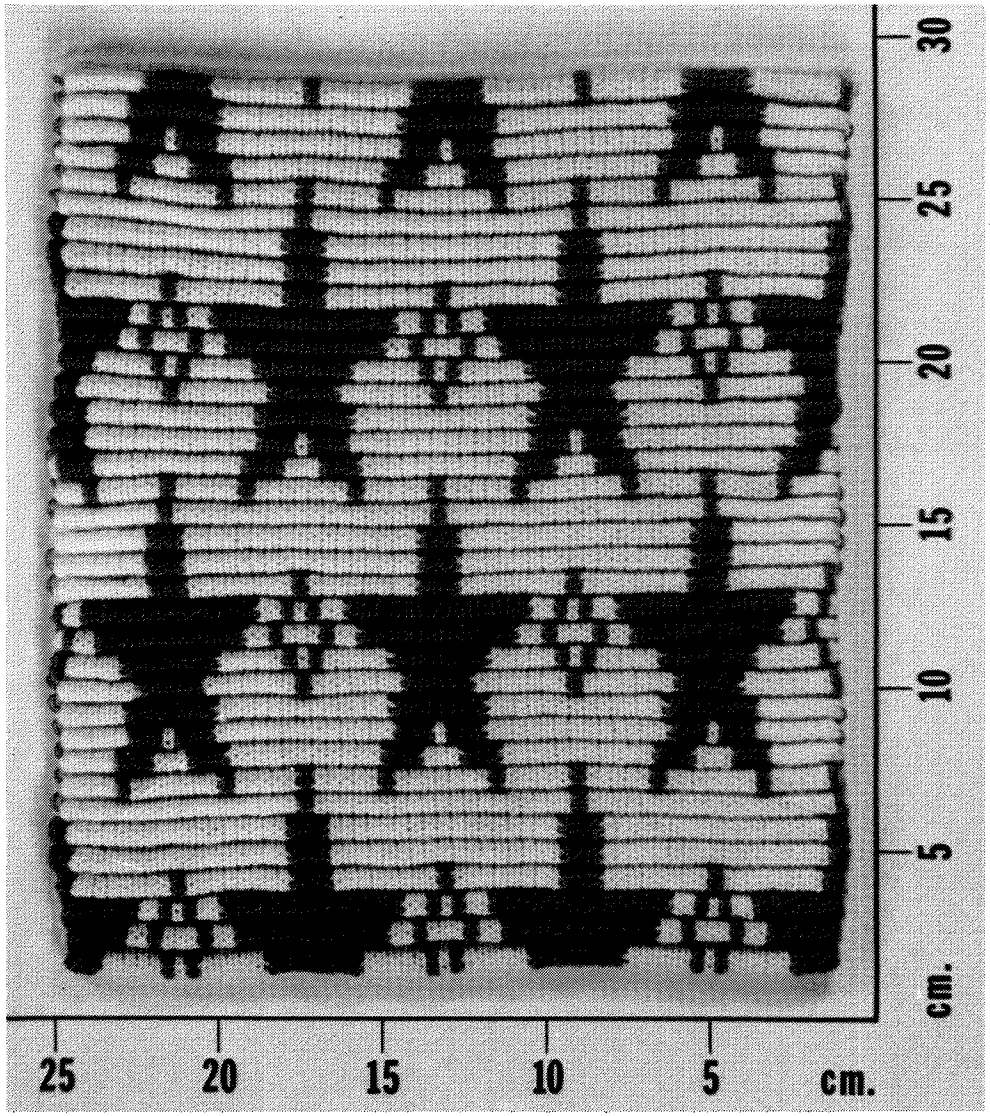
This two-color pin tuck looks similar to two-color punch pin tuck, but is knitted so both colors form one continuous pin tuck across the width of the fabric. The pin tuck is formed on the main bed; two rows of each color are knitted alternately with the same design and background needle selection until enough rows have been knitted to form the pin tuck for that pattern row. Then the pin tuck is attached to the backing with two rows of full needle rib, which also enclose the floats of each color within the pin tuck. The sequence repeats for the next pattern row.

This fabric is easiest to knit on European machines because of the arrow keys and reversers, which allow knitting the same alternating design and background needle selection several times in succession while the card rotation is stopped. On the Japanese machines, a Type C card must be manually rotated back and forth between two punched rows for each pin tuck. We suggest, therefore, using a card such as card number 1 from the basic pack for these machines, punched in an alternating 1x1 pattern. This will allow continuous alternating needle selection to knit a stripe or checkerboard if the card is punched 2x2 or 3x3, without having to stop the card or move it backward. In all cases, the pin tucks are made on the main bed.

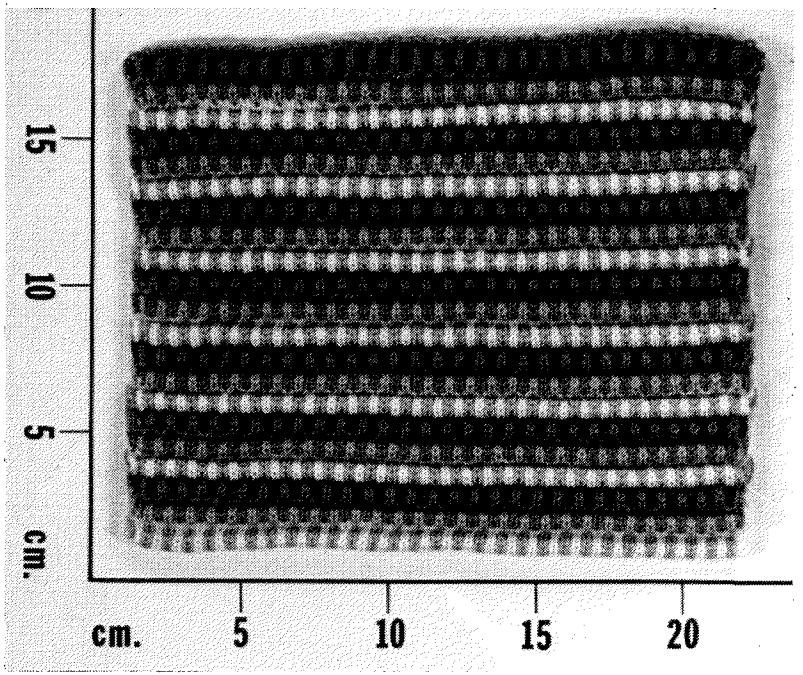
	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Basic Pin Tuck in Jacquard two colors	*Type A* RC2 col 1, RC2 col 2 } 2-5 times GX / BX← Deco 2, uncoupled then: RC2 col 1 or 2 N / N move Deco for next patt row	Type A stop card RC2 col 1, pos rev; RC2 col 2, neg rev } 2-5 times o / o ; then: RC2 col 1 or 2 ∧ / ∧ move to next patt row claw	1x1 card *from* basic package RC2 col 1, RC2 col 2 } 2-5 times part ↔ / part ↔ ; then: RC2 col 1 or 2 plain / N N	1x1 card from basic package RC2 col 1, RC2 col 2 } 2-5 times △ slip △ / o ← o ; then: RC2 col 1 or 2 △ stock △ / 1 ← 1



Basic pin tuck in two-color jacquard. Extra needle on backing.



Basic pin tuck in two-color jacquard, for European machines using jacquard Pattern 9. A ten row pin tuck knitted with 2 colors alternating 2 rows each, with the same ndl selection for the 10 rows. The card is stopped at each pattern row.

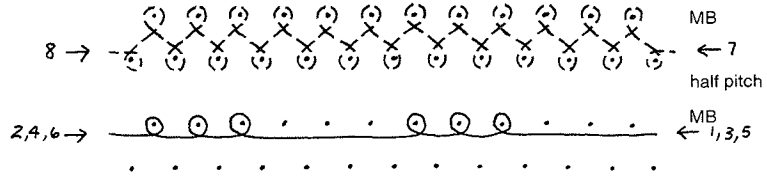


Basic pin tuck in two-color jacquard for Japanese machines. 1x1 card (or 2x2, 2x1, etc.) from the basic pack. The punchcard is allowed to rotate continuously with the same design in each pin tuck but in different colors. Six-row pin tuck.

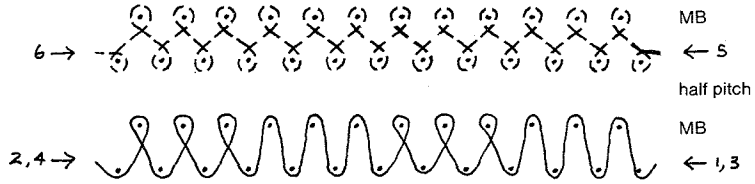
EMBOSSED RIPPLES IN TWO COLORS

For embossed pin tuck and nopps, needles are selected to knit only the raised design with color 1, while the flat background is made plain, in color 2. In pin tuck, floats will pass across non-selected, or background, needles. In nopps, tuck loops will be gathered in non-selected (background) needles as well as in all the needles of the backing. Then, in both fabrics, *all* needles on both beds knit with color 2 for two rows in full needle rib, which will either enclose the floats or knit off tuck loops. These two rows not only knit the backing but also the background for the pattern. There is no needle selection for color 2. Both pin tucks and nopps will be formed on the main bed. Type A punchcards can be used on all machines, but the punchcard must be stopped each pattern row, since needle selection is required only for the pattern and not for the background. In embossed pin tucks, it is necessary to carry the weft yarn completely across the fabric each row, by knitting both selvedge needles on the second bed with the color 1 yarn during each pin tuck row.

	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Embossed Pin Tucks two colors	Type A RC 6-10 col 1 BXo push ea end WP / BXo Deco 2, uncoupled ; RC2 col 2 N / N move Deco for next patt row	Type A stop card RC 6-10 col 1, pos or neg rev o / o ; RC2 col 2 ∧ / ∧ move to next patt row claw	Type A stop card RC 6-10 col 1 part ↔ / part ↔ ; RC2 col 2 plain / N N , move card to next row	Type A stop card RC 6-10 col 1 △ slip △ / o ← o ; RC2 col 2 △ stock △ / 1 ← 1 ; move card to next row
Embossed Nopps two colors	Type A RC4 col 1 AXo 1 push ea end WP / AXo Deco 2, uncoupled ; RC2 col 2 N / N move Deco for next patt row	Type A stop card RC4 col 1 pos or neg rev ⌒ / ↓ ⌒ ↓ ; RC2 col 2 ∧ / ↓ ∧ ↓ Selvedge ndls FB to HP every row move to next patt row claw	Type A stop card RC4 col 1 tuck ↔ / tuck ↔ ; RC2 col 2 plain / N N Selvedge ndls ribber to HP every row: HCL N, N move card to next row	Type A stop card RC4 col 1 △ tuck △ / o ∩ o ; RC2 col 2 △ stock △ / 1 ∩ 1 Selvedge ndls ribber to HP every row. Russel levers II *move card to next row*

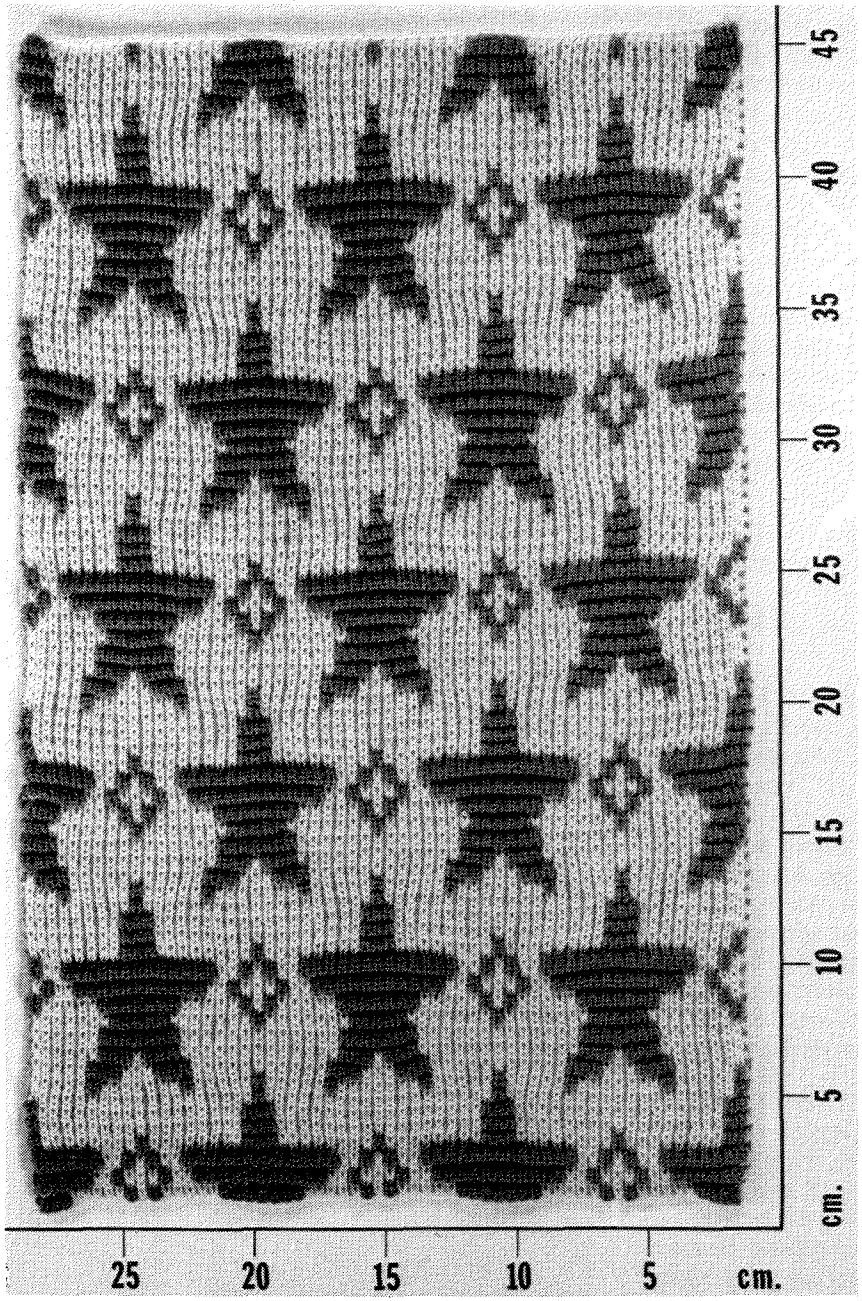


Embossed pin tuck. Extra needle on backing.

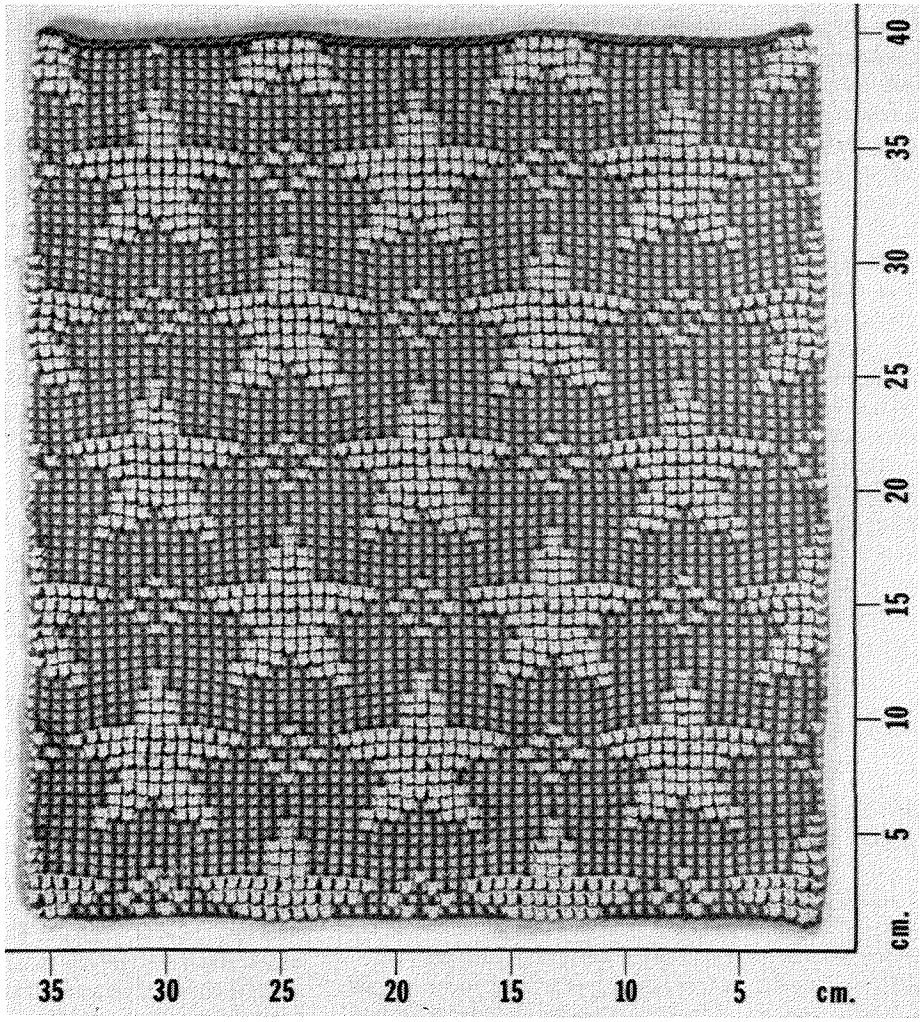


Embossed nopps. Extra needle on backing.

Embossed pin tucks and nopps. Knitted with jacquard Pattern 9. Only the design forms ripples; the background is flat.

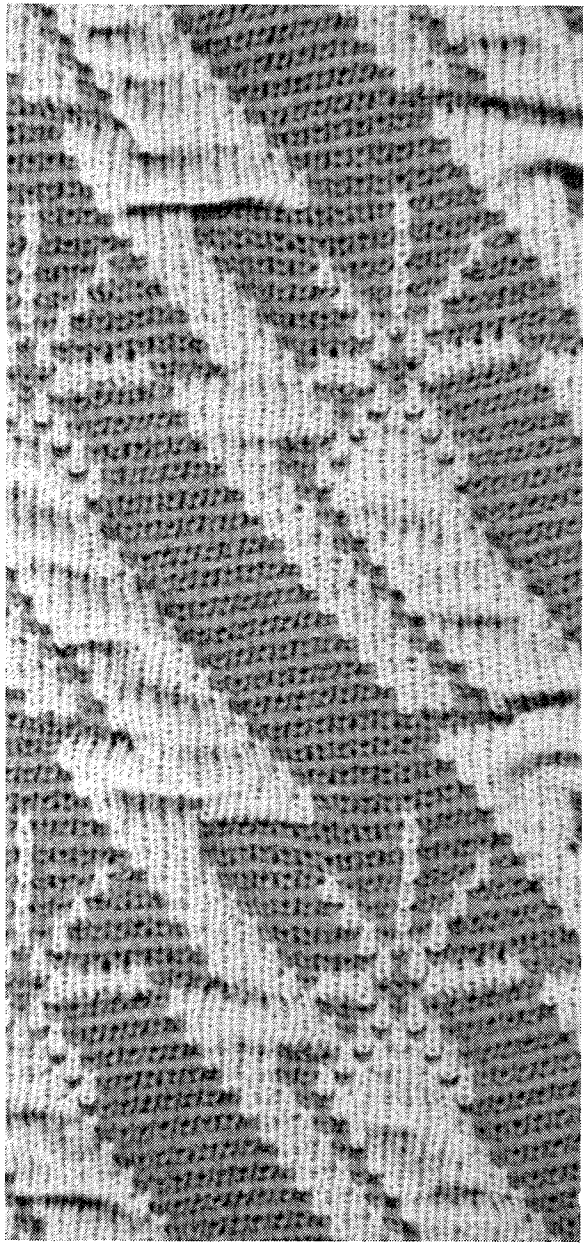


Embossed pin tuck.

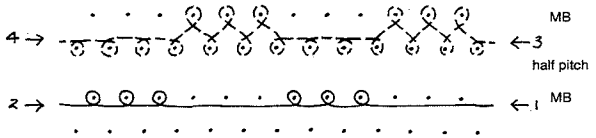


Embossed nopps.

CHAPTER 4
Blister Jacquard



If ripple fabrics intrigue you, then you will certainly be fascinated with blister fabric. Blister is a double bed jacquard technique. As its name implies, it is a fabric with design areas that separate from the backing and puff up from it like blisters. The blisters are in stockinette, knitted in color 1 on the main bed only. There will be wefts, or floats, from one blistered area to the next across the background stitches, which are knitted in color 2. These background stitches on the main bed and the backing stitches on the second bed are knitted together in full needle rib in color 2, which at the same time encloses the wefts from color 1. The area on the backing behind the blister is also stockinette stitches. Therefore the face of the fabric will show the blistered design in color 1 on a flat background of color 2; the reverse of the fabric will be solid in color 2.



Rows 1 and 2: design needles knit the blister in color 1 (solid line). Rows 3 and 4: background and backing needles knit in color 2 (broken line), enclosing wefts from the blister color.

Blister is similar in many ways to two-color embossed pin tuck, described in Chapter 3. The principal difference is that in blister, the background stitches (color 2) on the main bed require needle selection rather than being knitted plain across the width of the fabric. Blister fabric shares characteristics with all weft knit fabrics: there is little stretch across the width, and its texture is firm and comparatively thick.

VARIATIONS IN BLISTER

There are several ways to knit blister fabric, depending on the effect you want. You can use up to four colors per row. The design can be blistered on a flat rib background, as described above, or you can have a blistered background with a flat design in rib. The extent of blistering is variable: the blister can be perfectly flat if knitted with the same number of rows for both rib and blister, or it can be very bubbled if several blister rows are knitted for each rib row.

The backing, although flat and in a solid color, will shadow the design on the face. The backing behind the blister is in stockinette, hence these stitches are comparatively smaller; the rest of the stitches, knitted in rib, are comparatively larger. The fabric face also can be knitted flat, allowing the blister to appear in the stockinette of the backing instead. It will be a raised blister in one color.

Punchcards for rib jacquard can be used to knit blister jacquard: Type A for European machines and Type C for Japanese machines. Two cam settings are usually involved, one for the blister rows and one for the rib rows. Also, to knit a raised blister, the card must be stopped on the blister rows so the extra rows can be knitted with the same needle selection. Cards punched for two colors per row can be used to knit in two colors, or, for raised blister, in one color. Jacquard cards punched for three or four colors per row are quite successful with one or two colors for the blisters and the other one or two for the rib. The backing will be horizontally striped in the colors used for the rib rows.

TECHNIQUES FOR KNITTING BLISTER FABRICS

No matter which machine you use, there are a few points to remember in order to knit blister fabrics successfully.

1. Choose a *simple* pattern that has large enough design areas to show off the blister.

2. Plan the design so there are as many, or more, blister needles knitting in each row as rib needles. This will help prevent long wefts between groups of blister needles, which sometimes cause difficulty in knitting the blister rows. Long wefts can also be controlled by selecting a few needles on the backing between groups of blister needles to knit the wefts in a spotted or striped pattern during knitting of the blister rows. This effect is illustrated in the swatch photographs.

3. The stitch size on the bed knitting the blister should be from one-half to one size larger than on the bed making the backing. This makes the stockinette or blister stitches puff out more and also enables the rib stitches to better cover the wefts for less grin-through.

4. Extra weights are helpful, particularly in patterns with several rows of blister for each rib row.

5. The backing can be knitted either in full needle rib, with all backing needles knitting every row, or in bird's-eye backing, with alternate needles knitting/slipping on alternate rows. Bird's-eye will condense or shorten the fabric vertically, and will make a tighter backing and fuller blister. Full needle rib will elongate the design and allow more grin-through from the wefts, which can add a subtle textural quality to the design.

6. Two rows of full needle rib alternated with two rows of blister will result in flat blisters. Two rows of bird's-eye backing alternated with two rows of blister makes a slightly raised blister because there is one less row on the backing than on the face in every pattern row. The more blister rows added per rib row, the more pronounced the blister. The fabric also becomes thicker because of all the extra wefts.

7. In a raised blister fabric, the blister rows within each pattern row are knitted first, then the rib rows. In a flat blister, either blister or rib rows can be knitted first.

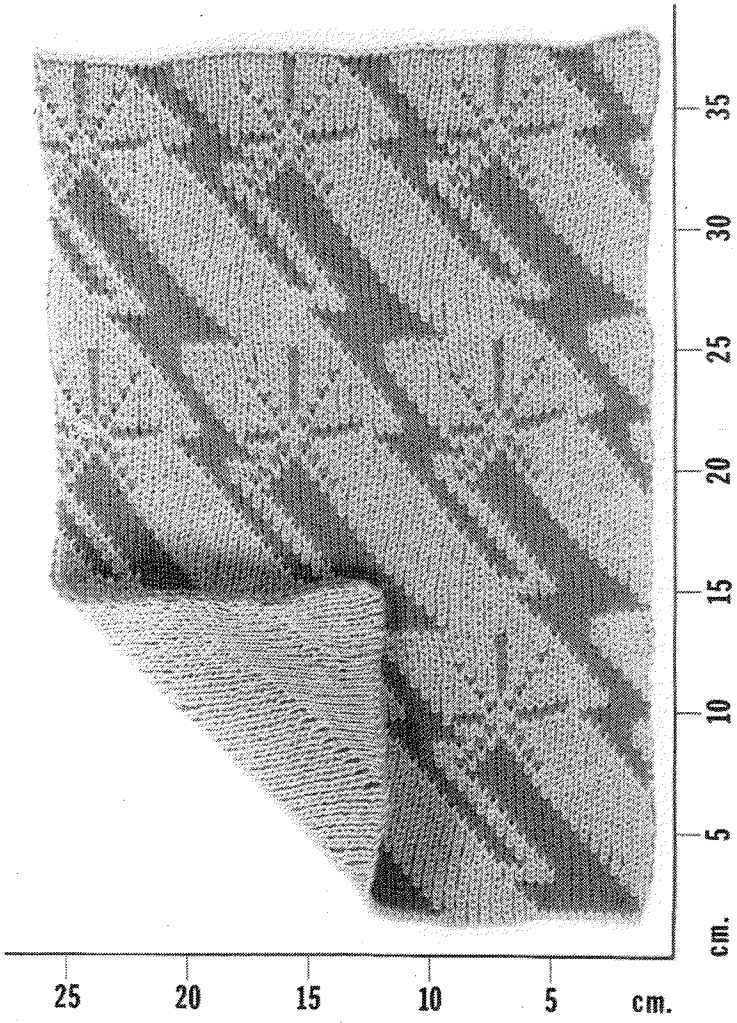
8. Motifs are very effective knitted in blister. Remember to hook the blister yarn around the last selvedge needle on the side opposite the color changer, each time the carriage is on that side, so the weft is carried completely across the fabric. Otherwise only one side of the background around the motif will enclose a weft, and the fabric will become unbalanced. It may also be necessary to do this with certain all-over patterns which have a large background or rib area next to the selvedges. An extra needle on the second bed can accommodate the wrapped yarn.

9. If you want blisters in more than one color, as in a fabric with three or four colors per row, there will be a weft yarn in each blister color enclosed within each rib row. The fabric will be thicker and firmer across the width, and will have more grin-through between rib stitches. If the pattern is simple, this results in a rich, mosaic-like background.

10. Superba machines can do a special version of blister using the double feed system for jacquard. Make the stitch size on the front bed about one number smaller than that on the back bed to make the blister more pronounced. For cam settings and swatch, see Superba Specials in Chapter 1.

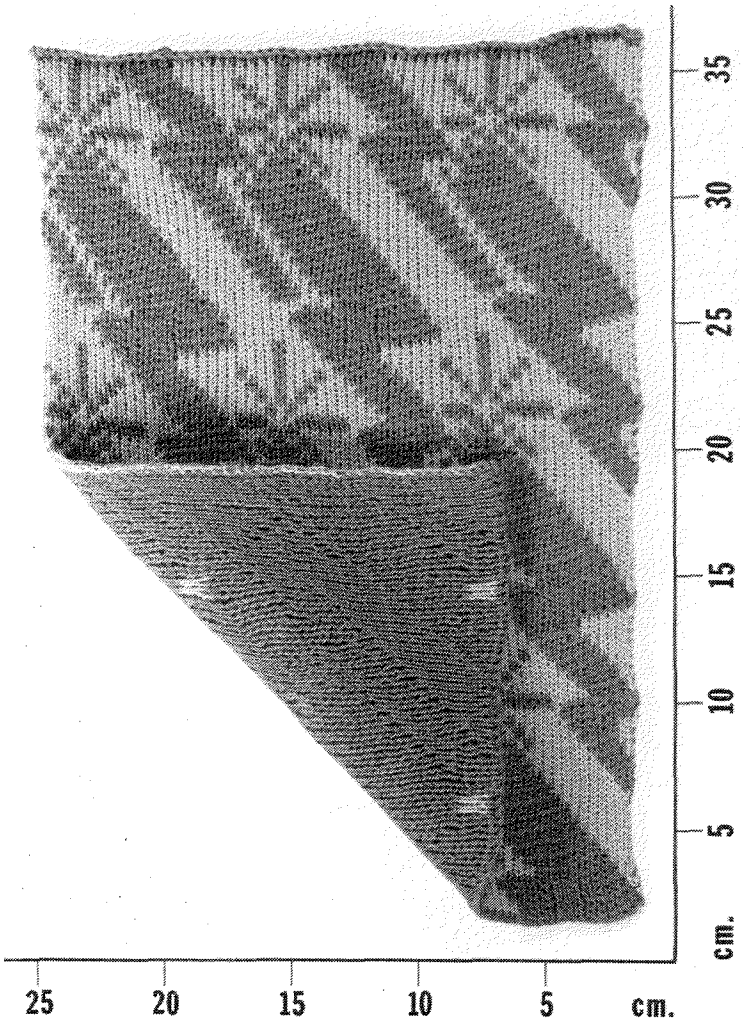
	Passap carr R	**Superba** carr L	**Brother/Knitking** carr L	**Singer/Studio** carr L
Flat or Single Blister **either blister or rib rows can be knit first**	Type A BX ← push RP or WP, + 1 at L opp / BX ← Deco 4 RC2 ea col	Type A stop card RC2 col 1, neg rev o / o ; RC2 col 2, pos rev o / Λ hook blister yarn around last ndl EOR advance card manually See also Rib Jacquard Superba Spec. claw	Type C1 - EOR Type C2 - ER RC2 col 1 part ↔ / part ↔ ; RC2 col 2 part ↔ / N N hook blister yarn around last ndl EOR	Type C1 - EOR Type C2 - ER RC2 col 1 △ slip △ / o ⌢ o ; RC2 col 2 △ slip △ / 1 ⌢ 1 hook blister yarn around last ndl EOR

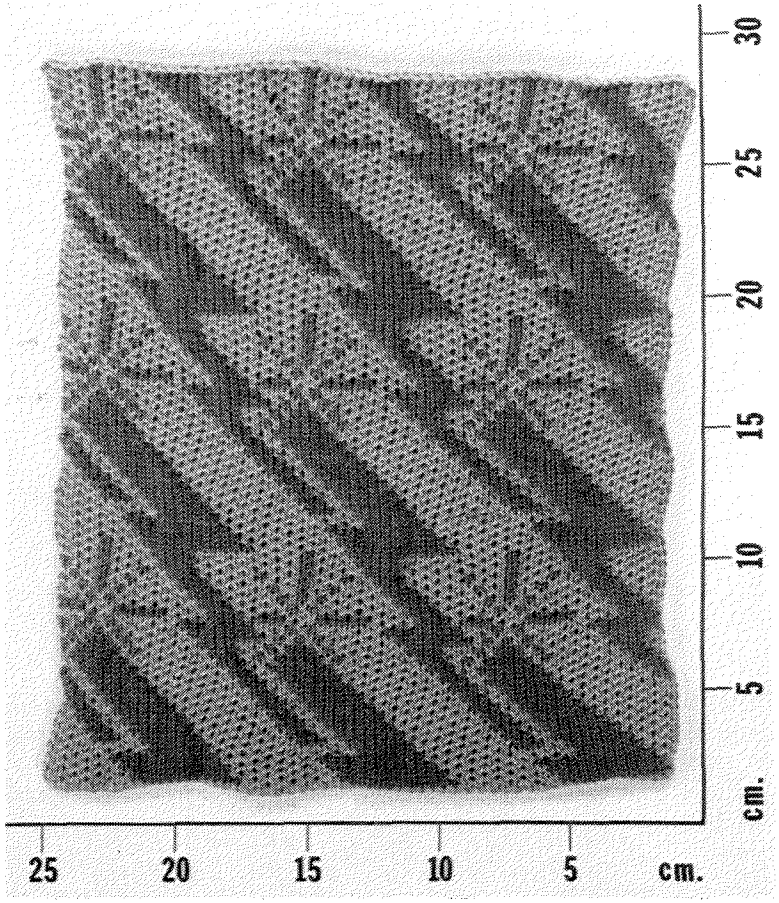
Flat blister knitted with jacquard Pattern 6. No needle selection on backing, RC2 each color. Two blister rows = 2 rib rows. Blister design, rib background.



	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Flat Blister Var: Birds-eye Backing	Type A RC2 col 1 GX ↔ push 1x1 WP/RP ; BX ← Deco 4 hook yarn around last ndl at L RC2 col 2 BX ↔ BX ←	Type A stop card RC2 col 1, pos rev o ; o hook yarn around last ndl at L RC2 col 2, neg rev o lili o lili use even # ndls FB advance card manually claw	Type C1 - EOR Type C2 - ER RC2 col 1 part ↔ ; part ↔ hook yarn around last ndl at R RC2 col 2 part ↔ lili part ↔ lili use even # ndls ribber	Type C1 - EOR Type C2 - ER RC2 col 1 △ slip △ ; o ← o hook yarn around last ndl at R RC2 col 2 △ slip △ o ← o select odd ndls, then even ndls ER

Flat blister knitted with jacquard Pattern 6. Two needles were selected on backing to knit the blister color for six rows, to control the long wefts at midway point of each lightning bolt. Blister background, rib design.

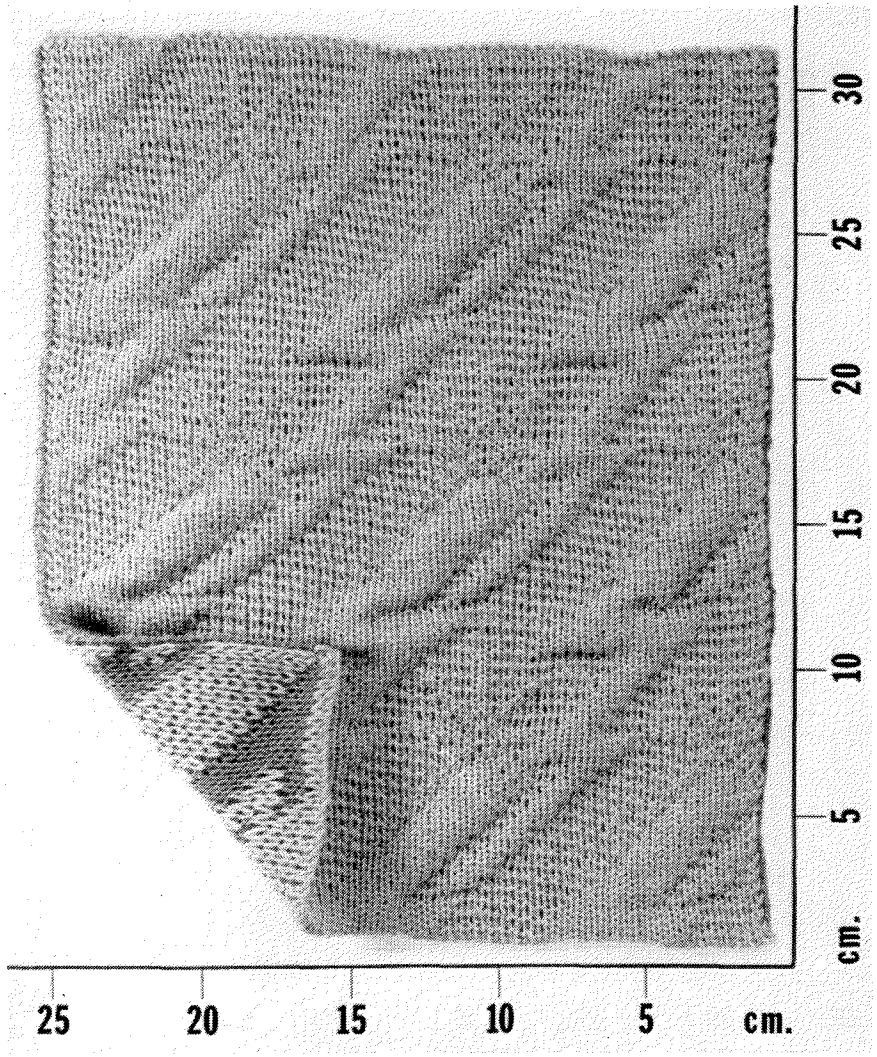




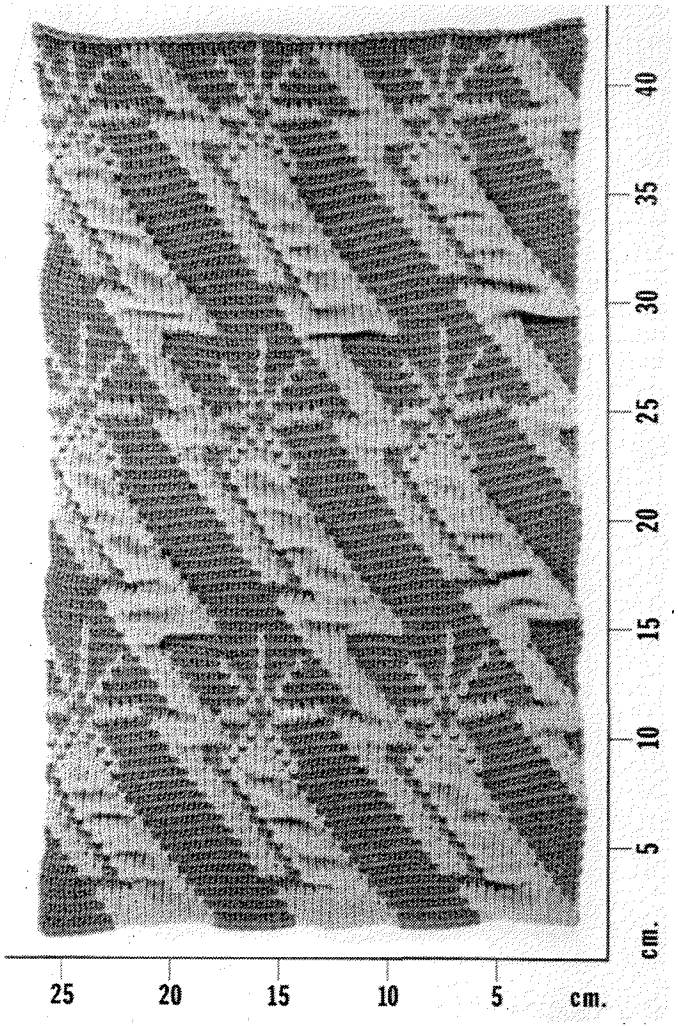
Flat blister knitted with jacquard Pattern 6. Made with bird's-eye backing on rib rows, RC2 each color, which causes the blisters to be slightly raised. Background has characteristic bird's-eye texture. Two blister/background rows = 1 backing row. Blister design, rib background.

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Flat Blister Var: Blistered Backing	Type A BX ← push WP + 1 ea end RP / HX ← Deco 4 RC2 ea col	Type A *stop card* RC2 col 1, pos rev C / o RC2 col 2, neg rev C / Λ No R cursor stop. Cursor at carr R throughout. *Advance card manually.* claw	Type C1 - EOR *Type C2 - ER* RC2 col 1 part ↔ / part ↔ ; RC2 col 2 part ↔ / N N push back selected ndls MB EOR, both colors.	Type C1 - EOR *Type C2 - ER* RC2 col 1 o slip △ / o ← o ; RC2 col 2 o slip △ / 1 ← 1

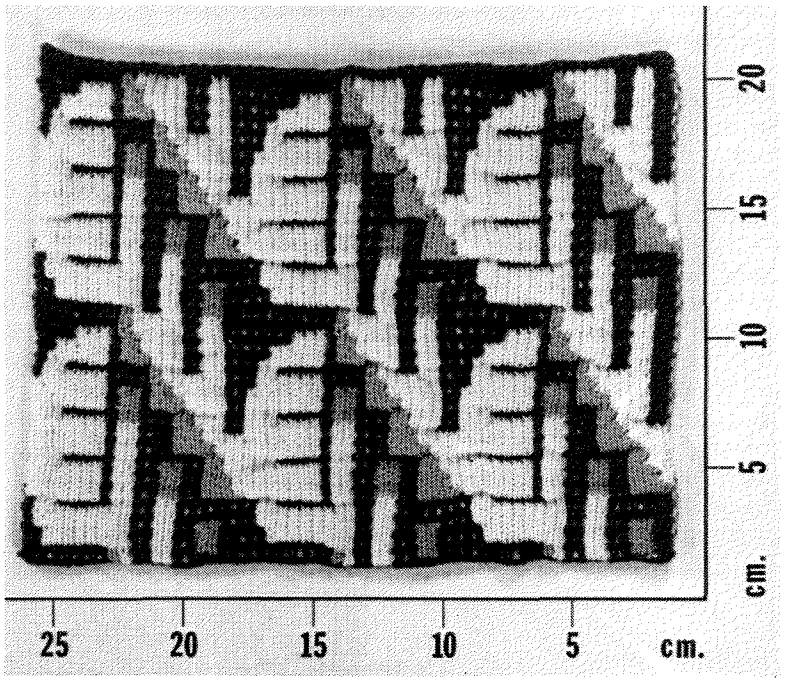
Raised blister on backing, using jacquard Pattern 6. Fewer rows are knitted on the face than on the backing, causing the stockinette areas of the backing to be raised in a blister. One blister/background row = 2 backing rows. Blister design, rib background.



	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Raised Blister 2 color	Type A RC4 or more col 1 BXo 1 push ea end WP ; / BXo Deco 2, uncoupled RC2 col 2 N / BX ←	Type A stop card RC4 or more col 1, pos rev; o / o hook yarn around last ndl ea end RC2, col 2 neg rev o / Λ advance card manually claw	Type C1 - EOR stop card RC4 or more col 1 part ↔ ; / part ↔ hook yarn around last ndl ea end start card RC2 col 2 part ↔ / N N	Type C1 - EOR stop card RC4 or more col 1 △ slip △ ; / o ← o hook yarn around last ndl ea end start card RC2 col 2 △ slip △ / 1 ← 1

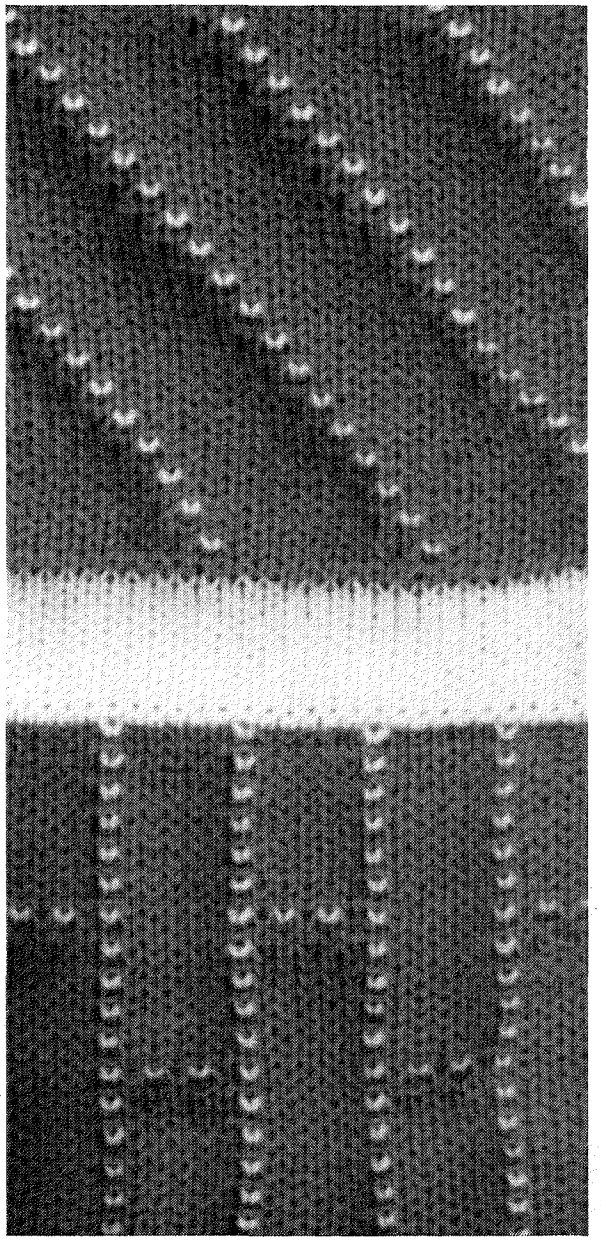


Raised blister on fabric face, using jacquard Pattern 6. Four blister rows knitted with same needle selection (card stopped), followed by 2 rib rows with second color. Blister design, rib background.



Raised blister in 3 colors using jacquard Pattern 13 (card Type D). Colors 1 and 2 are knitted 4 rows each with card stopped for blister, then 2 rows knitted in rib with color 3 for the background/backing. Blister design, rib background.

CHAPTER 5
Double Fabrics



The techniques in this chapter take us in another direction, into the double fabrics: eight-lock, quilting, and interlock. They present some interesting challenges.

EIGHT-LOCK

Eight-lock, also known as *double jersey,* is a two-layered jersey or stockinette fabric. It is made on a double bed machine, usually in two colors. The two layers of stockinette are knitted simultaneously, one on each bed, and joined at selected intervals across each row to form a reversible two-faced fabric.

The term "eight-lock" comes from the knitting industry. Industrial eight-lock fabric also is made on double bed machines, either flat bed or circular. They are fitted with two sets of carriages (four altogether), one set for each of two colors. Each carriage has two cams to knit or slip the needles in the pattern, for a total of eight cams. The German word for cam is "lock," thus the fabric became known as "eight-lock."

Eight-lock technique is particularly suitable for making reversible two-color jacquard fabrics, and for making one- or two-color quilted fabrics which can then be stuffed.

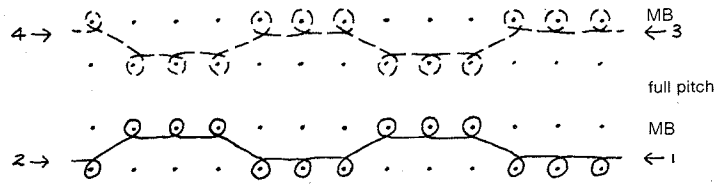
The stitch formation diagram shows how the joining of the two fabric layers occurs. As you can see, the beds are set at full pitch and the needles selected on both beds must be alternating with each other. Cams are set to slip on both beds. When a given group of needles on one bed is knitting, those exactly opposite on the other bed are slipping.

If you follow the diagram, your knitting will form narrow vertical tubes, three needles wide, where the two fabrics are joined by threads crossing between the beds. The tubes will alternate in color, and the colors will be reversed on each face. Note that the selvedge needles on each bed knit at the selection opposite that of their neighbors in order to close the selvedges.

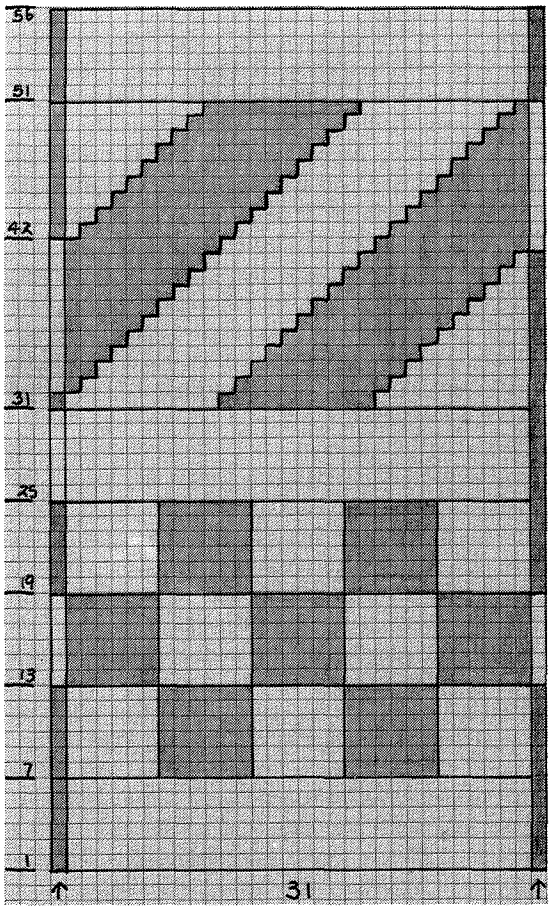
Eight-lock can be knitted in one color instead of two. Then alternating needle selection can occur every row instead of every other row. As in tubular knitting, two passes of the carriages are required to complete one row of fabric knitted in a single color. But if two colors are used, then four passes of the carriages are required for two rows of fabric.

When punchcards are used to knit eight-lock jacquard fabrics, identical cards will be needed for the reader on the main bed and for the Jac 40 to select needles on the second bed. A good example is the airplane pattern illustrated in the Jacquard chapter. On one side of the fabric the airplane is in color 1 on a color 2 background; on the other side the colors are reversed. If you use a geometric jacquard pattern you'll see unexpected changes in the pattern because of transposition of colors on each side of the fabric, as illustrated in the photograph of jacquard Pattern 7.

A variation of eight-lock, reversible tuck, uses exactly the same needle selection technique, but beds are set at half pitch and cams are set for tuck. It is a completely different fabric from the eight-lock discussed here, although it also is reversible. (The technique for reversible tuck is discussed in the Jacquard chapter.)

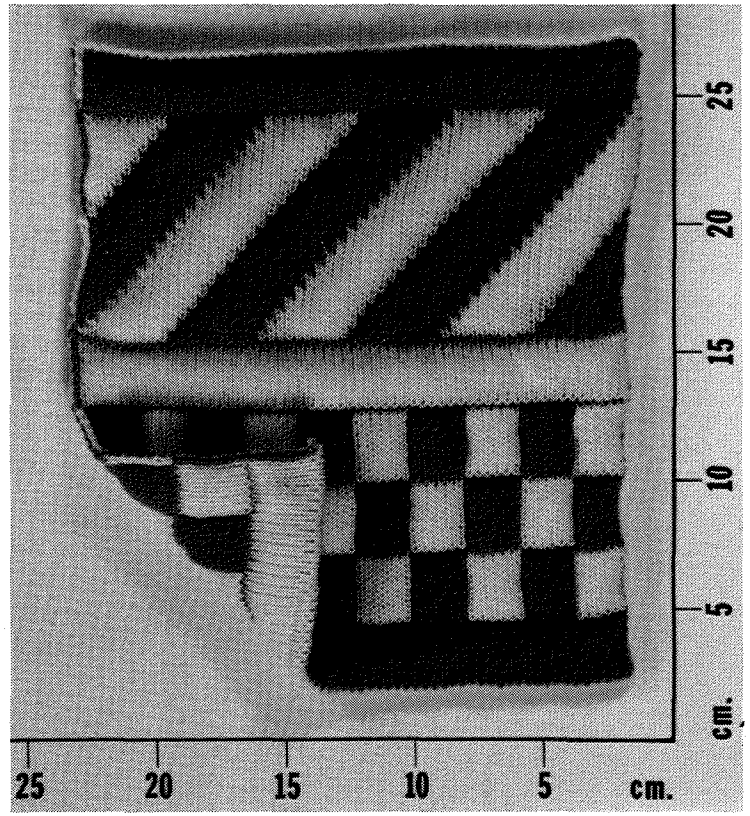


Eight-lock in two colors. Can be knitted in one color if selection is alternated every row.

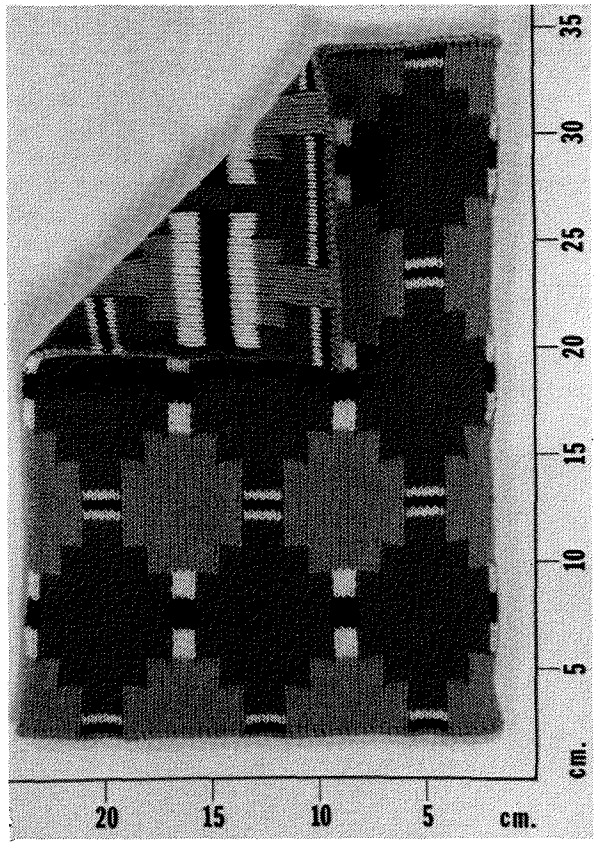


Eightlock. Dark squares indicate color 1; white squares color 2. One square = 1 stitch and 2 knitted rows (RC2 each color = RC4 each square). The arrows indicate the extra stitches to close the selvedges. One repeat = 30 stitches; 56 pattern rows.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Eightlock and interlock 1 color manual, punchcard, or combination	BX ↔ push WP/RP BX ↔ push RP/WP	o / o ndl pos 1/2 / 2/1 Select opp ndls both beds ER; alternate the selection ER. Can use lili buttons front bed for interlock.	part ↔ / part ↔ ndl pos B/D / D/B Select opp ndls both beds ER; alternate the selection ER. Can use lili buttons ribber for interlock.	o or △ slip △ or o / o ↼ o ndl pos B/C / C/B Select opp ndls both beds ER; alternate the selection ER.
Eightlock and interlock 2 color manual, punchcard, or combination	BX ← push WP/RP BX ← push RP/WP RC2 ea color	o / o ndl pos 1/2 / 2/1 RC2 ea col. Select opp ndls both beds ER, alternate selection EOR. claw	part ↔ / part ↔ ndl pos B/D / D/B RC2 ea col. Select opp ndls both beds ER, alternate selection EOR.	o or △ slip △ or o / o ↼ o ndl pos B/C / C/B RC2 ea col. Select opp ndls both beds ER, alternate selection EOR.
Eightlock (Double Jersey) with jacquard patterning	Type A BX ← Jac / BX ← Deco 4 RC2 ea col. Back bed: pushers in WP, select with Jac to RP every RC4.	Type C1 - EOR Type C1 - Jac o / o RC2 ea col. On FB, move all ndls to pos 2, select with Jac to pos 1 ER, rotate card EOR. claw	Type C1 - EOR Type C2 - ER Type C1 - Jac part ↔ / part ↔ RC2 ea col. Ribber: move all ndls to D pos, select with Jac to B pos, ER, with rotation EOR.	Type C1 - EOR Type C2 - ER Type C1 - Jac △ slip △ / o ↼ o RC2 ea col. Ribber: move all ndls to C pos, select with Jac to B pos ER, with rotation EOR.



Eight-lock knitted in 2 colors, stuffed. Needles on both beds selected with a pattern ruler according to graphed design. After knitting each group of tubes, they are stuffed, then all are closed at once by knitting 1 row FNR.



Eight-lock knitted with jacquard Pattern 7, in 4 colors (2 colors per patt row). A Jac 40 with an identical card is used to select needles for the second bed. A Jac 40 with one card can be used for manual selection on both beds.

QUILTING OR MOCK EIGHT-LOCK

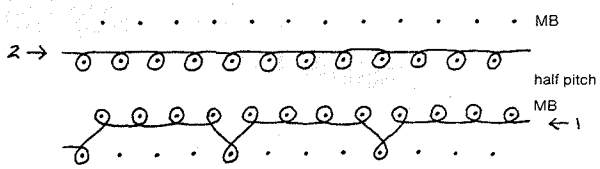
The quilting technique produces a fabric very similar to eight-lock, and one which is particularly suited to simple geometric patterns. Tubes are formed between the two layers of fabric, just as in eight-lock, although the join is made by a single stitch rather than by the yarn crossing between the beds. Quilting can be done more easily than eight-lock on the Japanese machines and Superba, since only single needles need to be selected to patterning or holding position. This can be done on one or both beds, with either a pattern ruler or punchcard. On Passap, needle selection is accomplished by placing single pushers in working position. As with eight-lock, this fabric can be given a quilted look when the pockets or tubes are stuffed during the knitting.

For one-color fabric, the cams are set for tubular knitting; individual needles *on one bed only* are pushed to patterning position or holding position (with cam set to knit them back), and one tubular round is knitted. The diagram illustrates the procedure.

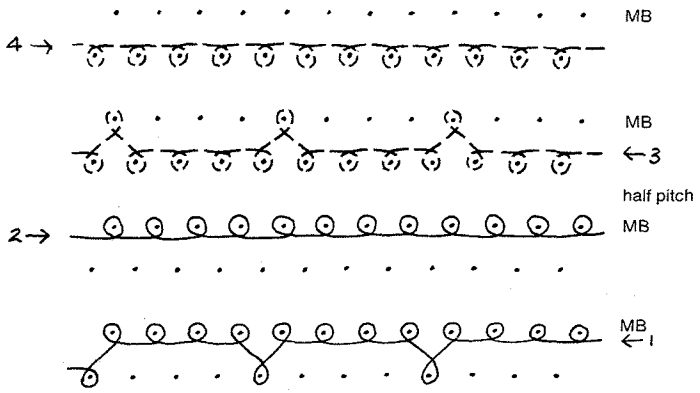
It is possible to knit a different color on each bed with the same technique, but not on a tubular cam setting. The two colors don't cross back and forth between beds except for the single stitches which join the two fabrics, so each face of the fabric is a solid color. The diagram shows how this occurs. Set the cams so the two beds will alternate knitting two rows. The last needles at the side opposite the color changer are always selected to close the selvedge, as in two-color eight-lock. Close the selvedge on the same side as the color changer by placing color 1 at the outside of the color changer to knit the front bed, and color 2 at the inside to knit the back bed.

When using either one or two colors, the needles selected to join the two faces knit one more stitch per pattern row than the other needles. With two colors, these stitches will alternate in color to form a linear pattern on both faces of the fabric, as shown in the diagram and in the swatch. It isn't really necessary to select needles on both beds when you use two colors. You can select needles on only one bed, with the opposite bed knitting plain, but then the linear two-color pattern will show on just one face.

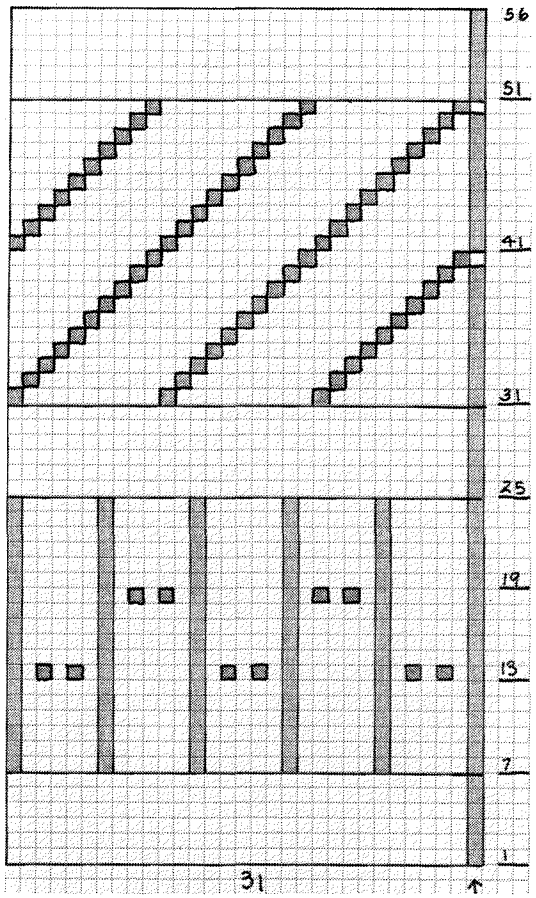
To close the tops of the tubes across the entire width of the knitting, in eight-lock as well as in quilting, knit one row of full needle rib at a tighter stitch size and with beds at half pitch. To close only some of the tubes, opposite needles on each bed can be selected to close while the rest continue to knit in pattern. If you plan to stuff the tubes, do so before closing! Simply drop the front bed and the tubes will open to receive the stuffing.



Quilting in one color, knitted tubular.

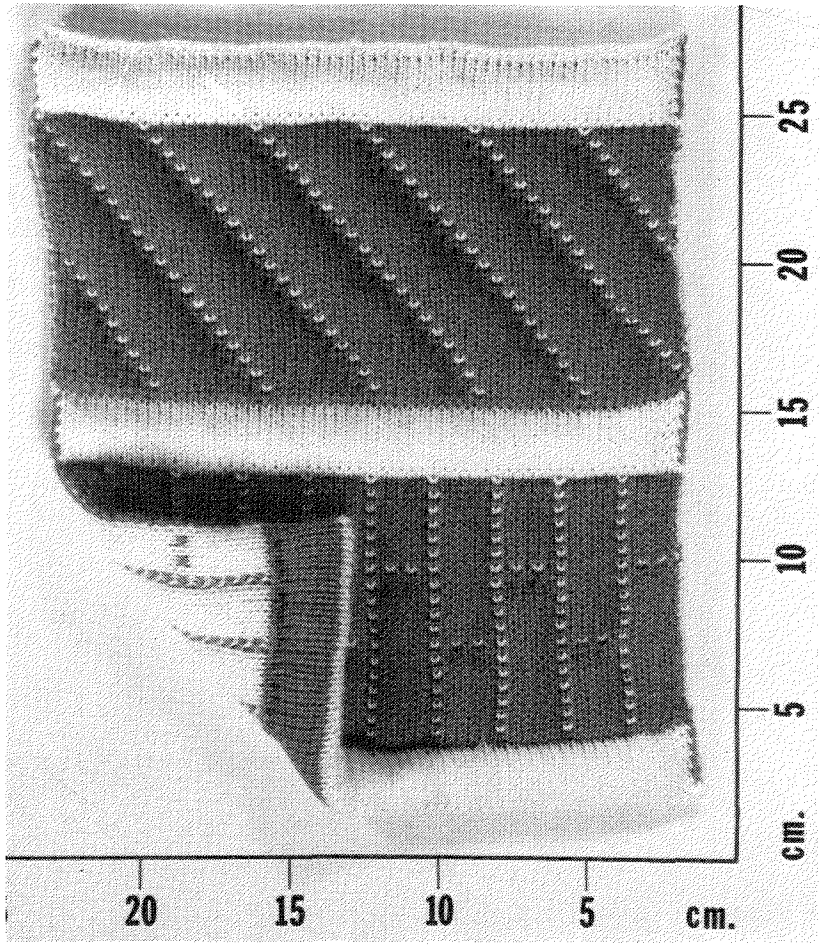


Quilting in two colors, with selection for joining in both colors.



Quilting. Dark squares indicate color 1; white squares color 2. One square = 1 stitch and 2 knitted rows (RC2 each color = RC4 each square). Thread the color changer this way: color 1 at outside; color 2 at inside to close selvedge. Arrow indicates an extra stitch at side opposite color changer to close selvedge. One repeat = 30 stitches x 56 pattern rows.

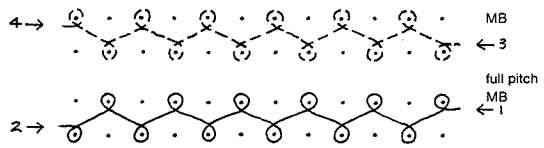
	Passap carr R	**Superba** carr R	**Brother/Knitking** carr L	**Singer/Studio** carr L
Quilting **1 color** **Select single ndls manually - EOR.**	RC1 BXo select single push WP ; / CX RC1 N / CX Select push back bed w carr R.	↓C↓ / ↄ Select single ndls on MB to HP with carr R.	part → / part N Select single ndls on MB to HP w carr L. HCL on MB - N.	△ slip o / o ← 1 Select single ndls on MB to HP with carr L. Russel Levers MB - II
Quilting **2 color** **Select single ndls manually EOR. Ndl selection during col 2 is optional.**	RC2 col 1 N / HXo ; RC2 col 2 HXo / N Pushers for selection in WP both beds.	RC2 col 1 ↓o↓ / ↓∧↓ ; RC2 col 2 ↓∧↓ / ↓o↓ Select single ndls to HP on bed that will slip, EOR. (1st row of each col) claw	RC2 col 1 part ↔ / N N ; RC2 col 2 plain / part ↔ HCL both beds - N. Select single ndls to HP on bed that will slip, EOR. (1st row of ea col)	RC2 col 1 o slip o / 1 ← 1 ; RC2 col 2 △ slip △ / o ← o Russel Levers both beds - II. Select single ndls to HP on bed that will slip, EOR. (1st row of ea color)



Stuffed quilting in 2 colors, with single ndls on both beds selected with a pattern ruler according to the graphed design. Colors on horizontal tubes can be reversed.

INTERLOCK OR DOUBLE RIB

Interlock fabric is made in exactly the same way as eight-lock, but is limited to a 1x1 needle selection, or at most, a 2x1 or 2x2 selection on both beds. The stitch formation diagram shows how the selection is made for 1x1 in two colors. In one color, the selection can reverse every row, just as in eight-lock.

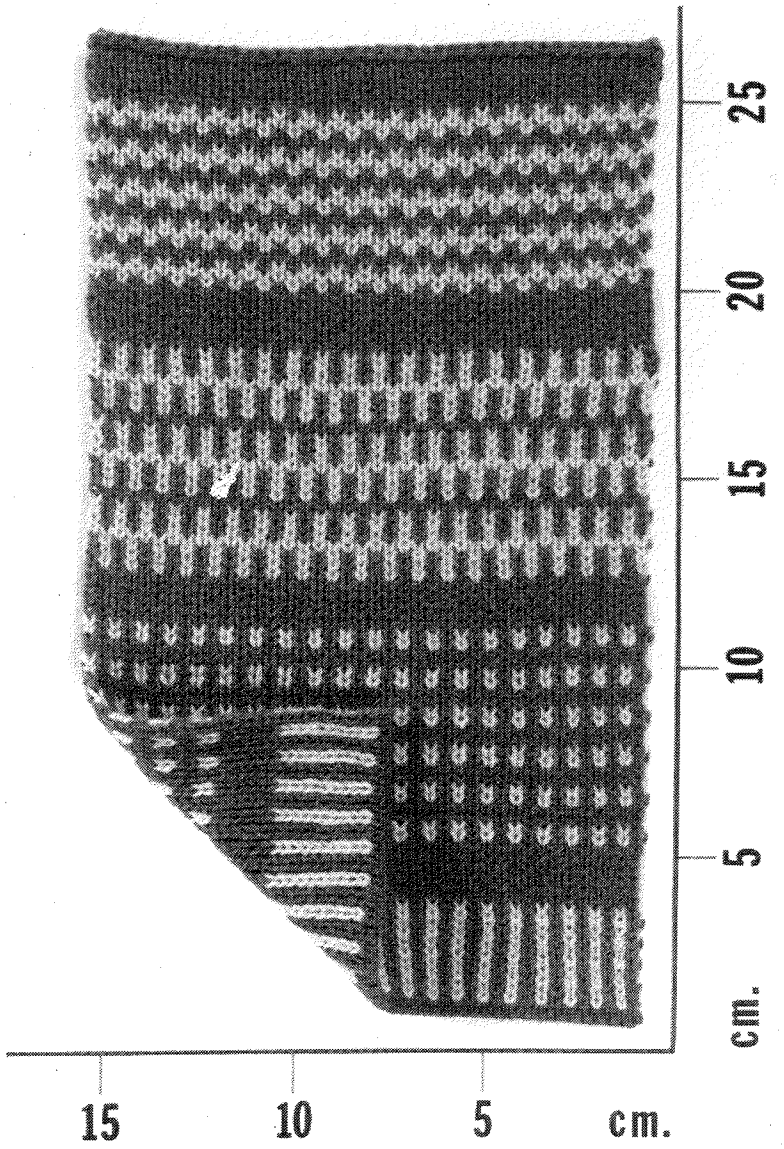


Interlock in 1x1 selection, knitted in two colors.

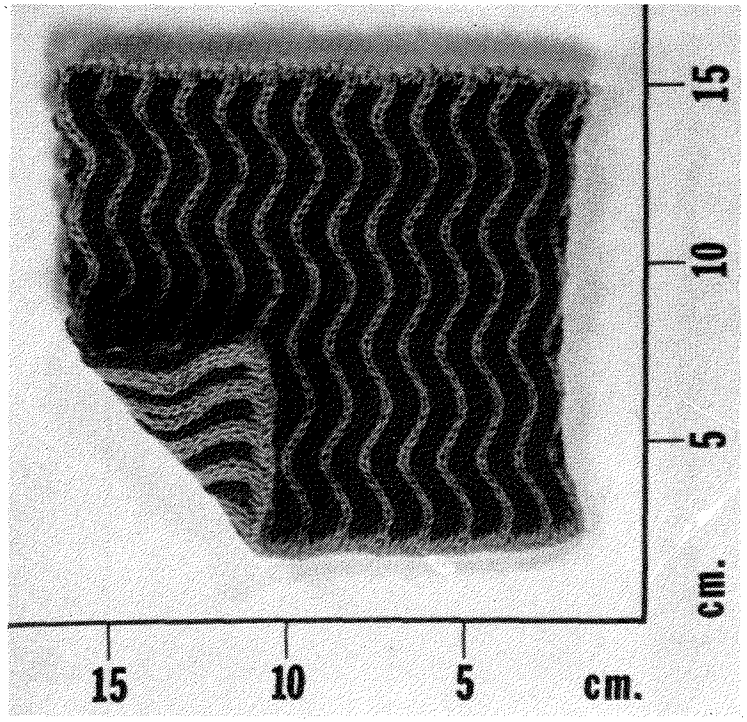
An interlock fabric knitted with a 1x1 selection looks, feels, and stretches like stockinette; but because it is doubled, it is thicker, more stable and doesn't curl at the selvedges. Knitted with a 2x1 or 2x2 selection, it forms reversible ribs.

Interlock can incorporate many variations. It can be embossed, racked, vertically or horizontally striped, or checked. The result, as in eight-lock, is a reversible fabric with the colors on each side also reversed.

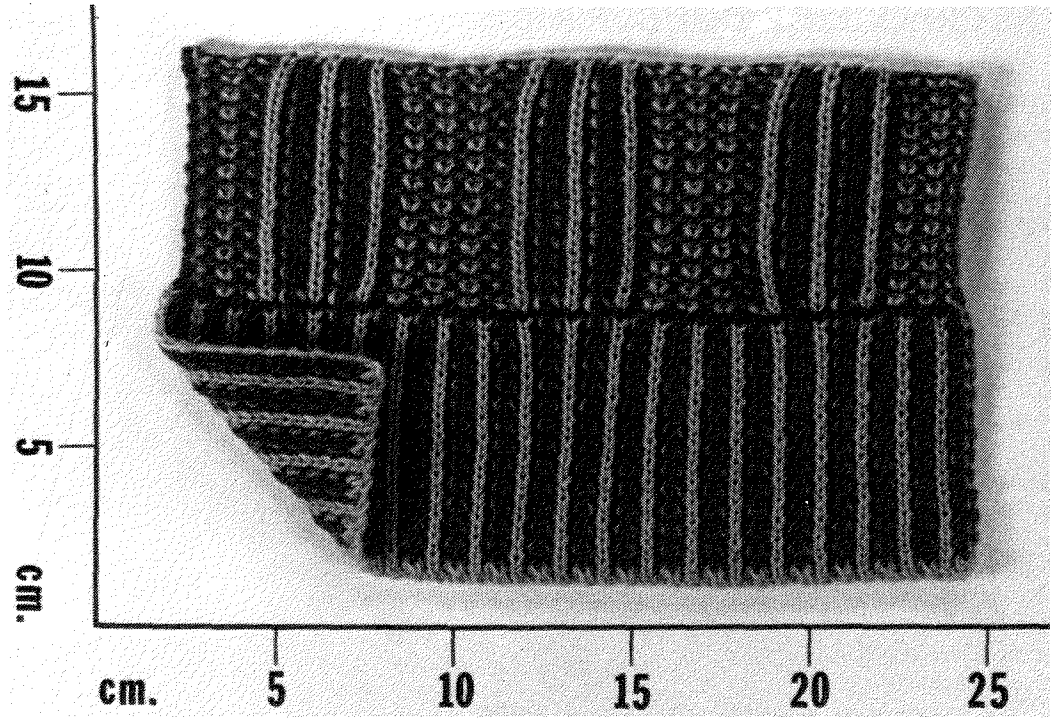
To knit basic interlock in a 1x1 selection in one color, select alternate needles on both beds every row. For two colors, select alternate needles on every other row. To knit interlock fabrics, refer to the cam charts illustrated in the Eight-lock section. This alternating needle selection of interlock is the underlying principle behind several other fabrics, such as the knit-weave fabrics. The Knit-weave chapter provides further information and shows an example of a basic one-color interlock fabric.



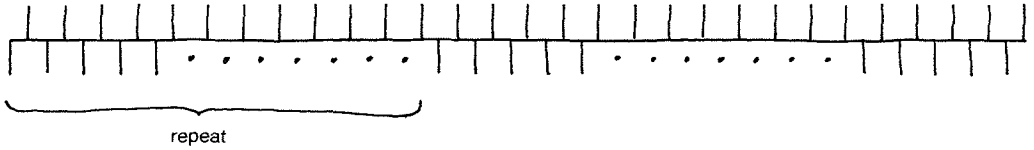
*Interlock sampler in 1x1 selection with patterns formed by variations in color changes. Needle selection is continuous 1x1 throughout, alternating EOR. Fabric is identical on both sides. Pattern 1 is at the bottom of the sampler and pattern 4 at the top: solid dark areas between patterns are RC12 col 2. Pattern 1: *RC2 col 1, RC2 col 2*. Pattern 2: *RC2 col 1, RC6 col 2*. Pattern 3: *RC2 col 1, RC2 col 2, RC4 col 1, RC2 col 2, RC2 col 1, RC4 col 2*. Pattern 4: Begin RC2 col 2 *RC4 col 2, RC 4 col 1*. End RC2 col 2.*



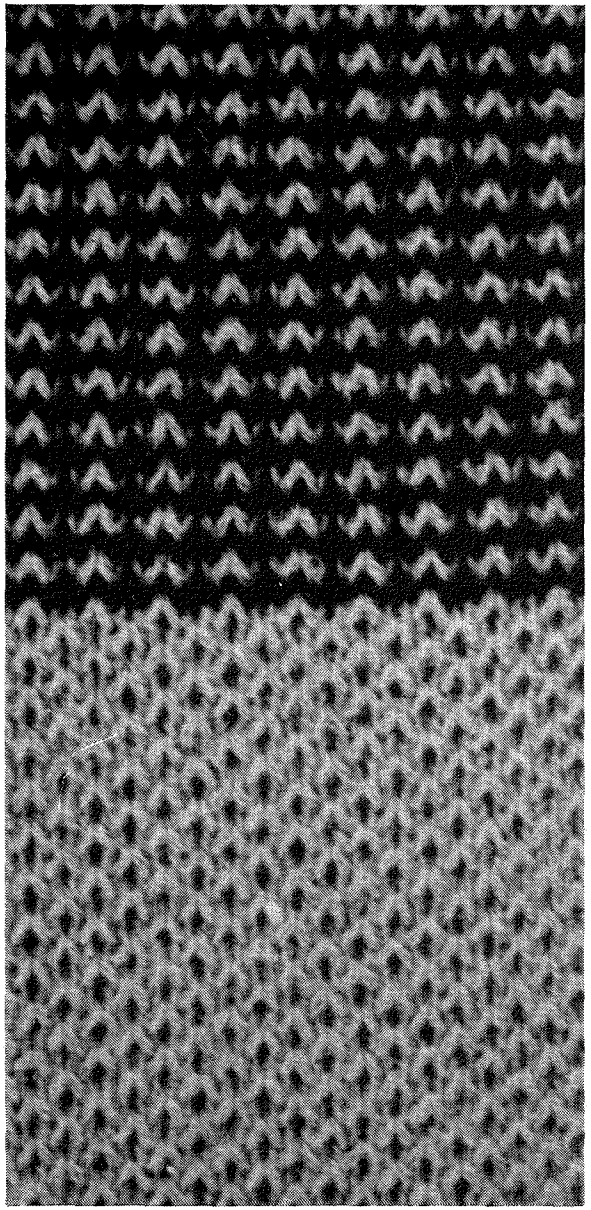
Interlock knitted with racking in a 2x1 selection; beds at half pitch. Knit RC2 each color, and rack one needle every RC2.



Tucked interlock with 1x1 selection. Both carriages set for tuck st; beds at half pitch.
Bottom: FNR set-up with RC2 each color.
Top: embossed set-up, knitted the same as bottom.



CHAPTER 6
Knit-weave Fabrics



Knit-weave, or knit-woven, is a term used in industrial knitting. In spite of its name, this fabric does not contain weaving elements or even look woven. Nor is it one of the inlay fabrics, often called by this name, which are described in Chapter 11. It is, rather, a run-resistant flat double bed fabric. Like weft knitting and weaving, knit-weave is so named because it has much the same firmness, smoothness and comparative lack of stretch as loom-woven cloth, yet it retains the suppleness of knitted textiles.

The knit-weave structure is characterized by one or two rows in rib alternated with one or two rows of single bed or tubular stockinette. The rib or "warp" rows are the "knit" part of knit-weave, the stockinette rows are the "weave" or "weft" rows. (In traditional weaving, the warp yarns run lengthwise on the loom and the weft threads weave crosswise.) The stitches on the stockinette rows, smaller than the rib stitches knitted at the same stitch size, force the fabric to contract crosswise *and* lengthwise, making it firm and smooth.

Knit-weave fabrics are especially good for coats, suits, skirts, pants and upholstery because they drape well and withstand stretching. Knit-weaves are particularly effective in very fine yarns because, although compact, the fabric is still light in weight. Moreover, this is a perfect cut-and-sew fabric. It doesn't curl at the edges, stretch, or run when cut. It won't catch in the sewing machine, or do any of those things which make you cringe at trying cut-and-sew construction. If you like to tailor, it is an ideal fabric. Many knit-weaves are identical on both faces, and all of them can be varied to suit your needs or fancy.

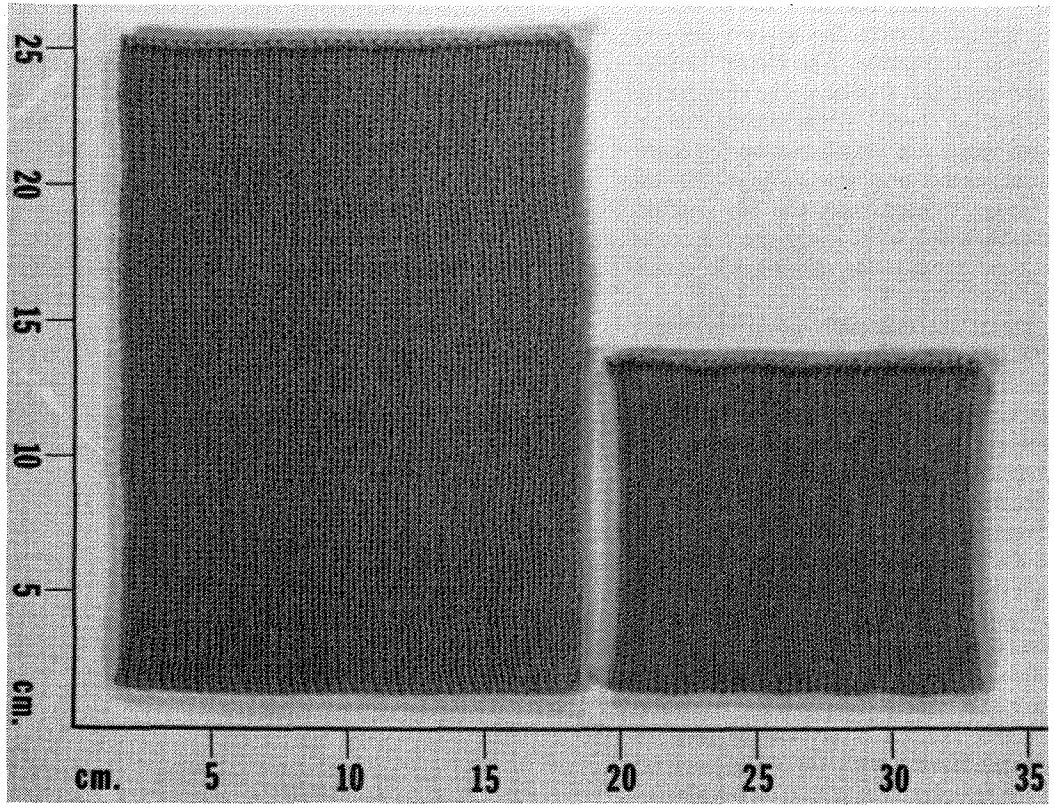
Quite a few knit-weaves can be made without needle selection on either bed; others require a 1x1 selection on both beds. A basic 1x1 punchcard can be used on the main bed for some fabrics, with rows of holes taped over if necessary. If selection is required on both beds, the punchcard can be coupled with selection by a 1x1 pattern ruler, or the lili buttons on Superba and Brother/Knitking. The cam charts give only manual selection for these fabrics on Superba and the Japanese machines; you can decide for yourself how to make a more automatic selection on your machine.

THE THREE BASIC KNIT-WEAVES

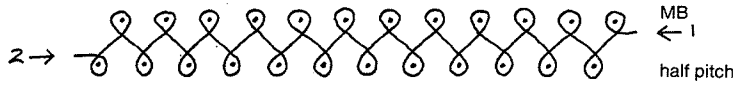
The photos illustrate swatches of these fabrics, knitted in one and two colors, to show the texture and to help you visualize the structure. The names we use for these fabrics are those used in the knitting industry, but we have also mentioned the other commonly used names.

The three basic types of knit-weave fabric which will be discussed below are classified according to the method by which the rib rows are knitted. These include full needle rib, interlock rib, and combinations of the two. All the swatches shown in the photographs are knitted 40 stitches wide and to RC96, so you can see the gauge differences in the various fabrics. The stitch size should be a little large for the rib stitches, so the stockinette stitches will then be fairly tight. In the fabrics knitted in two colors, the colors are changed every two rows, even in three- or five-row sequences. In the knitting directions, the slash indicates that the rows alternate: for example, "one row rib / one round tubular" means rib rows alternate with tubular rows.

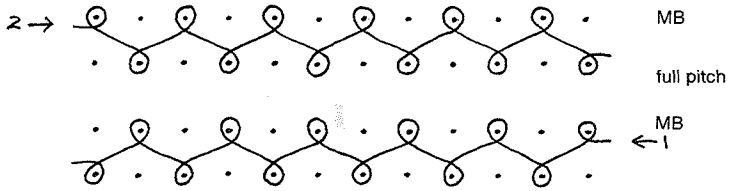
	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Full Needle Rib	N / N	∧ / ∧	plain / N N	stock / 1 1
Interlock Rib	BX ↔ / BX ↔ push 1x1 WP/RP / push 1x1 RP/WP	o / o (a) Select odd ndls / even ndls RC1; (b) Select even ndls / odd ndls RC1 Repeat (a & b)	part ↔ / part ↔ (a) Select odd ndls / even ndls RC1; (b) Select even ndls / odd ndls RC1 Repeat (a & b)	o slip o / o ← o (a) Select odd ndls / even ndls RC1; (b) Select even ndls / odd ndls RC1 Repeat (a & b)



Basic knit-weave fabrics.
Left. Full needle rib. RC1 makes one complete row of rib; all needles knit in consecutive order with each pass of the carriage.
Right. Interlock rib. RC2 makes one complete row of rib; alternate needles on both beds knit with each pass of the carriage. Both swatches have the same number of stitches and row counts; both were knitted with the same stitch size.



Full needle rib.



Interlock rib.

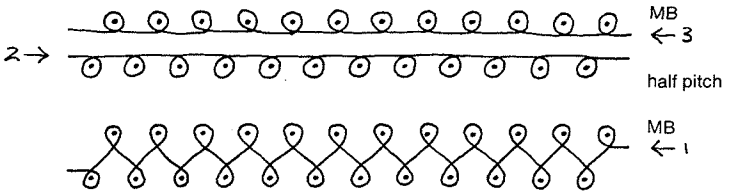
FULL NEEDLE RIB

All machines can knit these fabrics easily because, with the exception of triple knit rib, no needle selection is required on either bed. These fabrics are less compact than those in the other two groups. Beds are always set at half pitch to knit these.

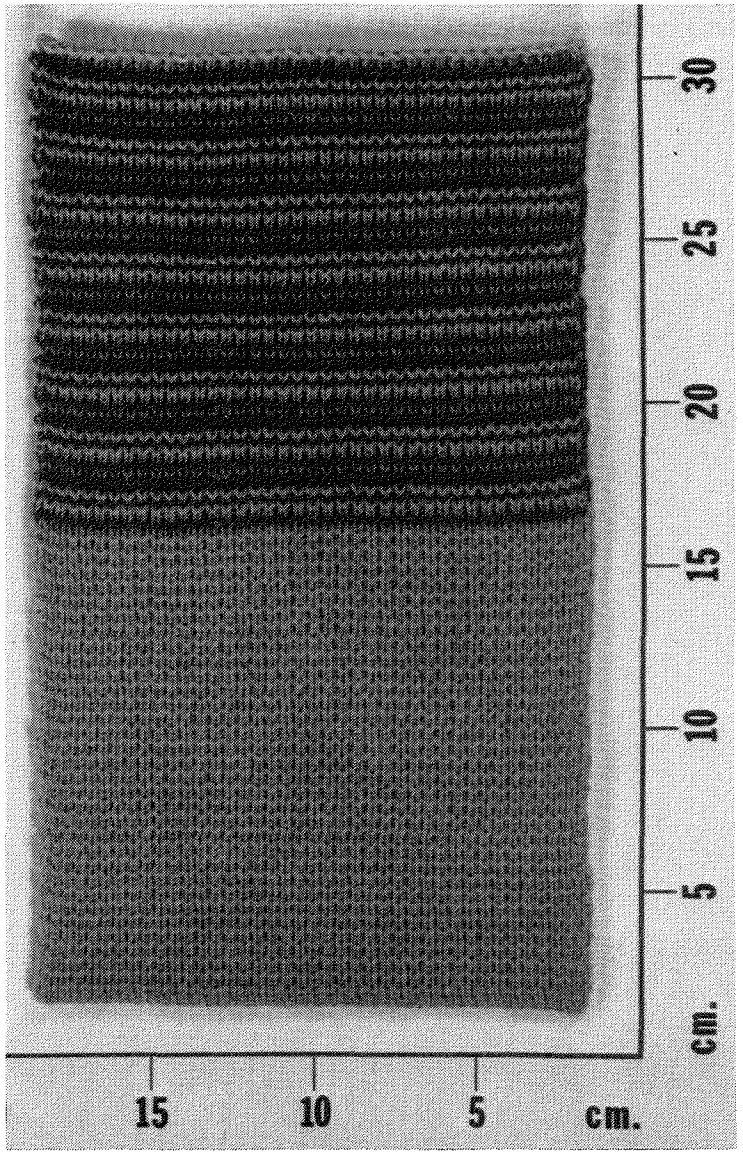
	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Milano Rib	RC1 N / N ; RC2 CX / CX	RC1 Λ / Λ ; RC2 C / C	RC1 plain / N N ; RC2 part ← / N part	RC1 o stock △ / 1 ← 1 ; RC2 o slip △ / 1 ← o

Milano Rib or Italian Stitch

One row rib / one round tubular = one repeat (RC3). Both sides of the fabric are identical, although when 2 colors are used, the color rows shift slightly between the face and reverse.



Milano rib.

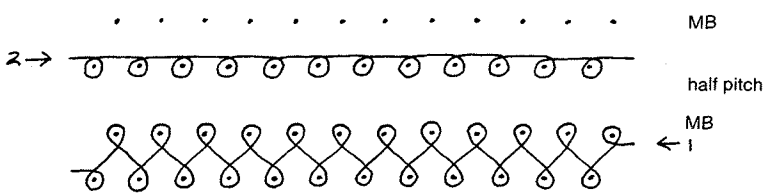


Milano rib.

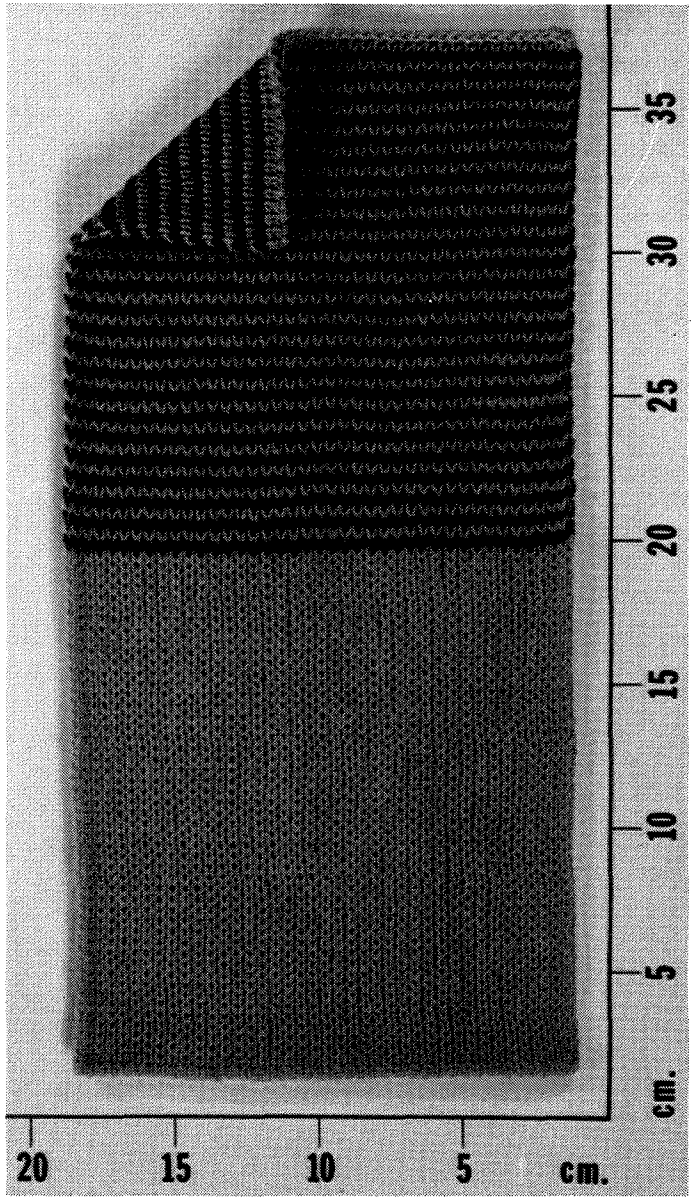
Half Milano or Long Stitch

One row rib / one single bed row (RC2) which is always on the same bed for each repeat. The two sides are not identical. This fabric is often used for embossed patterns; the extra (stockinette) row on the backing side stretches and flattens the stitches lengthwise for the embossed pattern on the opposite bed, making the pattern contrast sharply with the backing. If this fabric tends to curl during knitting, make the SS on the MB one-third to one-half number larger.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Half Milano	N / CX	C / Λ	part ← / N N	o slip △ / 1 1



Half Milano.

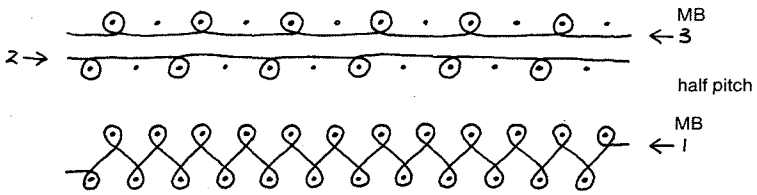


Half Milano.

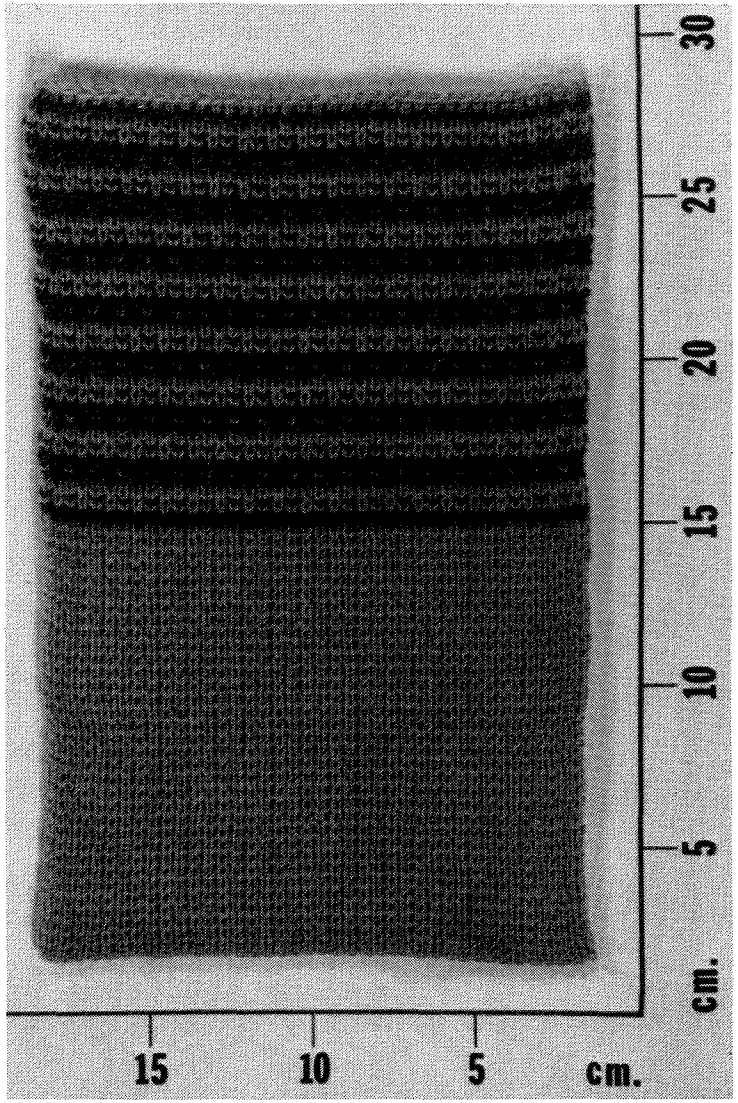
Triple Knit Rib

One row rib / one round tubular with alternate needles knitting and slipping (RC3). The same needles knit or slip in each tubular round throughout. Both sides of the fabric are identical, although in two-color work the color rows shift slightly between the face and the reverse.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Triple Knit Rib	RC1 N / N ; RC2 HXo / HXo push 1x1 WP/RP / push 1x1 WP/RP	RC1 ∧ / ∧ ; RC2 o / o Select odd ndls, each bed, on all tubular rows.	RC1 plain / N N ; RC2 part ↔ / part ↔ Select odd ndls, each bed, on all tubular rows.	RC1 o stock o / 1 ← 1 ; RC2 o slip o / o ← o Select odd ndls, each bed, on all tubular rows.



Triple knit rib.



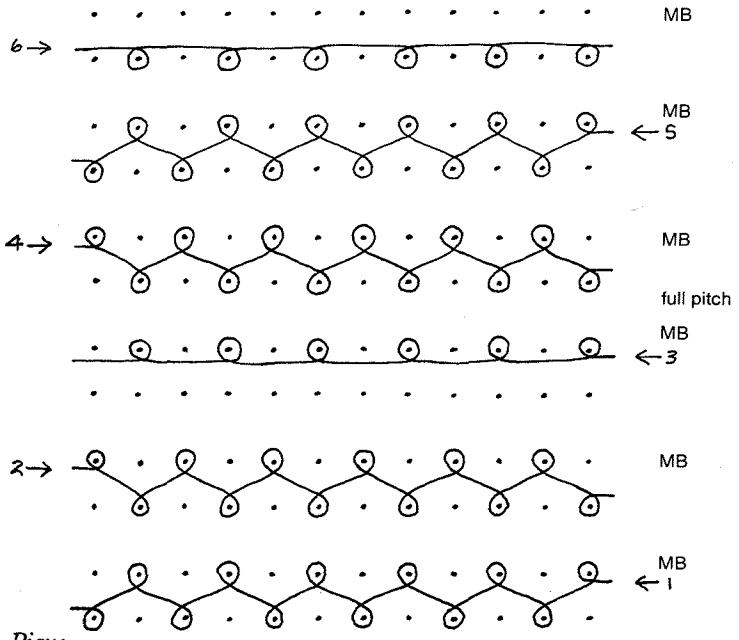
Triple knit rib.

INTERLOCK RIB

These fabrics are more compact than those in the other two groups. They require 1x1 needle selection on both beds. Beds are usually set at full pitch. On Passap, needles are selected by arranging alternate pushers WP/RP on both beds. On Superba and Brother/Knitking, needles are selected by lili buttons on the front carriage, and by a 1x1 punchcard on the back bed. On Singer/Studio, the 1x1 pattern ruler is used on the ribber, and a 1x1 punchcard for the main bed. Coordinate selection between beds so needles alternate, rather than clash! The "a" and "b" in the cam charts refer to the a and b sequences in the Interlock Rib cam chart on the second page of this chapter. For an introduction to interlock fabrics, see Chapter 5.

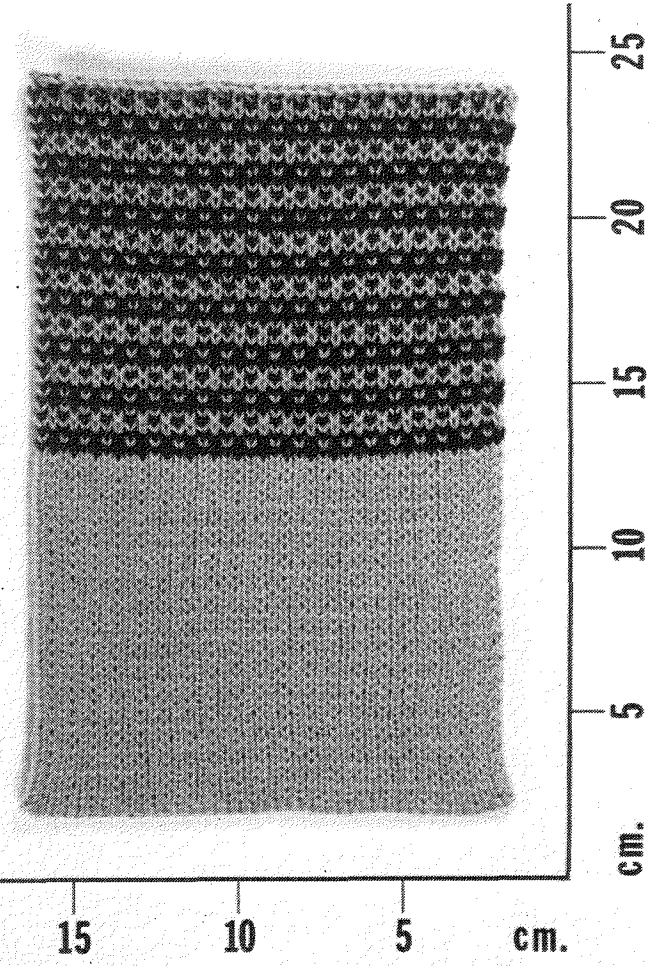
Pique

One row rib / one single bed row with alternate needles knitting and slipping (RC3). The single bed rows will alternate beds for each repeat, which means one complete repeat = RC6. Both sides of the fabric are identical, although when 2 colors are used, the color rows shift slightly between the faces.



Pique.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Pique	RC2 BX ↔ / BX ↔ ; RC1 BX ↔ / GX ↔ RC2 BX ↔ / BX ↔ ; RC1 GX ↔ / BX ↔ push 1x1 WP/RP / push 1x1 RP/WP	o / o RC2 Interlock Rib (a & b); RC1 select odd ndls MB; RC2 Interlock Rib (b & a); RC1 select odd ndls FB.	part ↔ / part ↔ RC2 Interlock Rib (a & b); RC1 select odd ndls MB; RC2 Interlock Rib (b & a); RC1 select odd ndls ribber.	o slip o / o ← o RC2 Interlock Rib (a & b); RC1 select odd ndls MB; RC2 Interlock Rib (b & a); RC1 select odd ndls ribber.

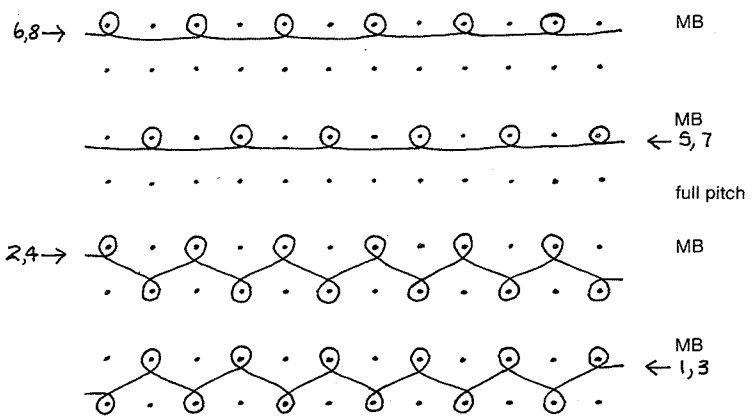


Pique.

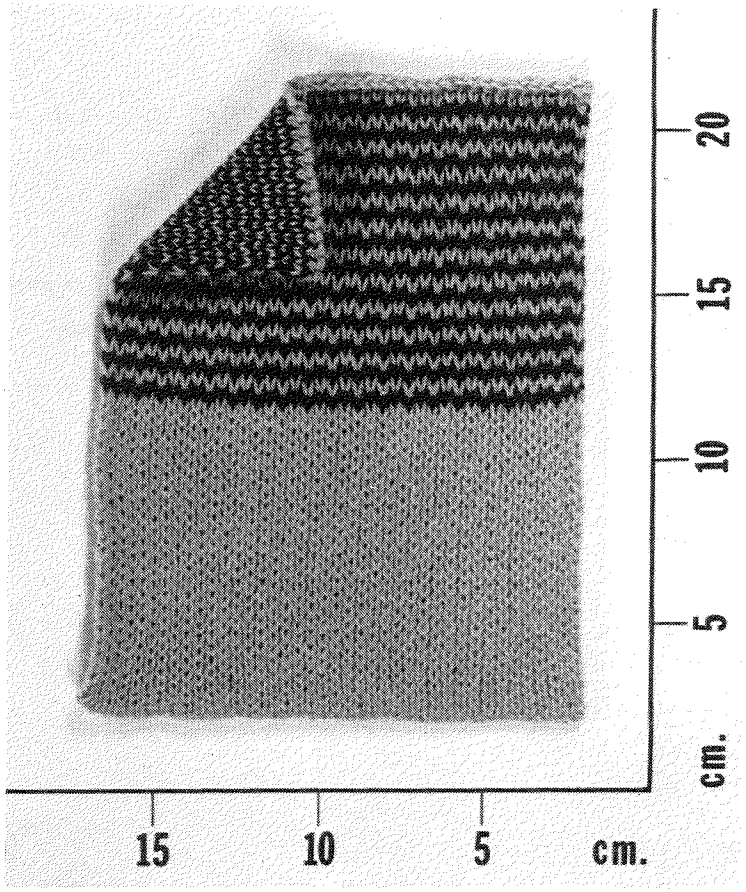
Bourrelet

Two rows rib (RC4) / four rows single bed with alternate needles knitting and slipping (RC8). The single bed rows are always on the same bed. The two sides of the fabric are not identical. In both pique and bourrelet, the stitches of single bed rows continue the alternating knit / slip sequence from the rib row.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Bourrelet	RC4 $\frac{BX \leftrightarrow}{BX \leftrightarrow}$; RC4 $\frac{BX \leftrightarrow}{GX \leftrightarrow}$ $\frac{\text{push 1x1 WP/RP}}{\text{push 1x1 RP/WP}}$	$\frac{o}{o}$ RC4 Interlock Rib (a & b; a & b); RC4 select odd, then even ndls ER, MB only.	$\frac{\text{part} \leftrightarrow}{\text{part} \leftrightarrow}$ RC4 Interlock Rib (a & b; a & b); RC4 select odd, then even ndls ER, MB only.	$\frac{o \text{ slip } o}{o \leftarrow o}$ RC4 Interlock Rib (a & b; a & b); RC4 select odd, then even ndls ER, MB only.



Bourrelet.



Bourrelet.

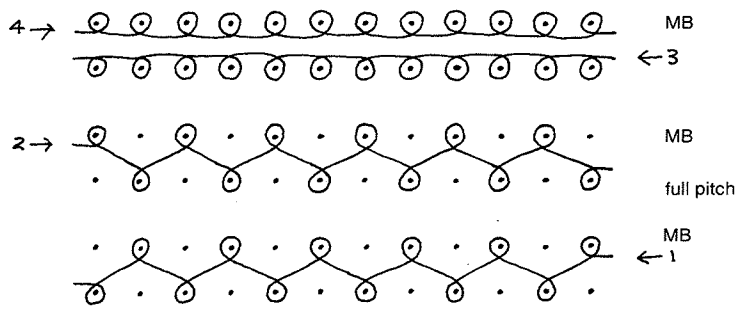
Ponte di Roma

One row rib / one round tubular with all needles knitting (RC4). Beds at full pitch. Both sides are identical.

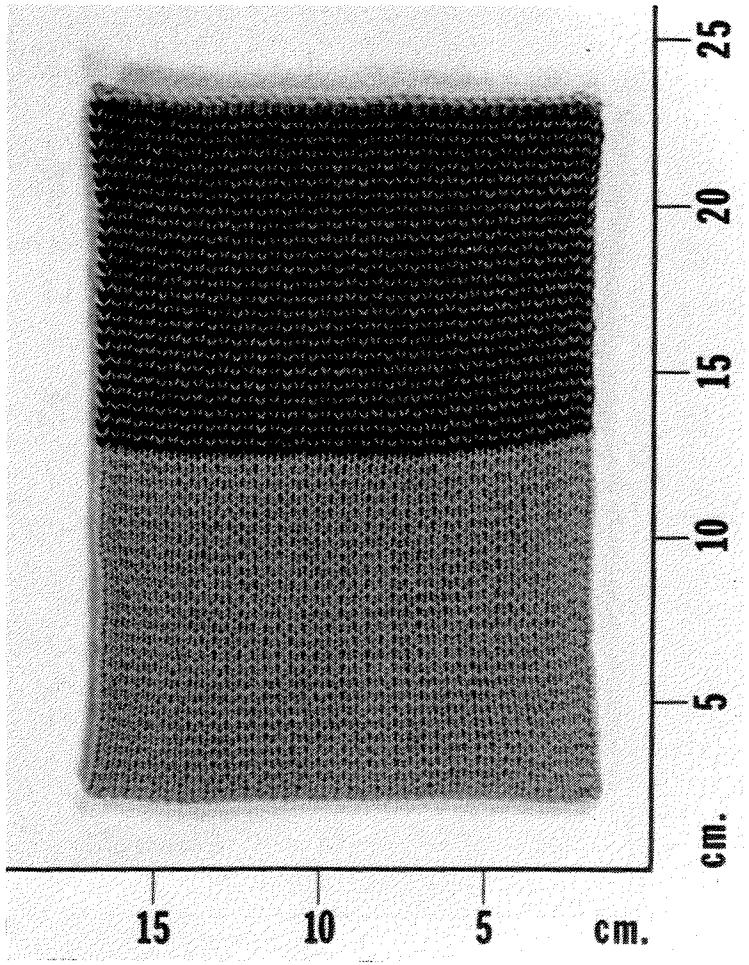
Evermonte

This fabric is made exactly like Ponte di Roma, but with beds at half pitch. It is slightly looser and the ribs tend to group together in pairs.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Ponte di Roma Evermonte	RC2 BX ↔ / BX ↔ ; RC2 CX ↔ / CX ↔ push 1x1 WP/RP / push 1x1 RP/WP	RC2 Interlock Rib (a & b) o / o ; RC2 C / ↻	RC2 Interlock Rib (a & b) part ↔ / part ↔ ; RC2 part ← / N part	RC2 Interlock Rib (a & b) o slip o / o ← o ; RC2 o slip △ / 1 ← o



Ponte di Roma.



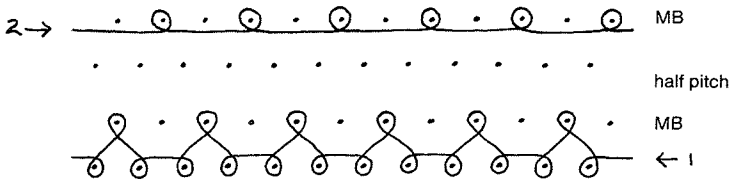
Ponte di Roma.

COMBINATION RIB

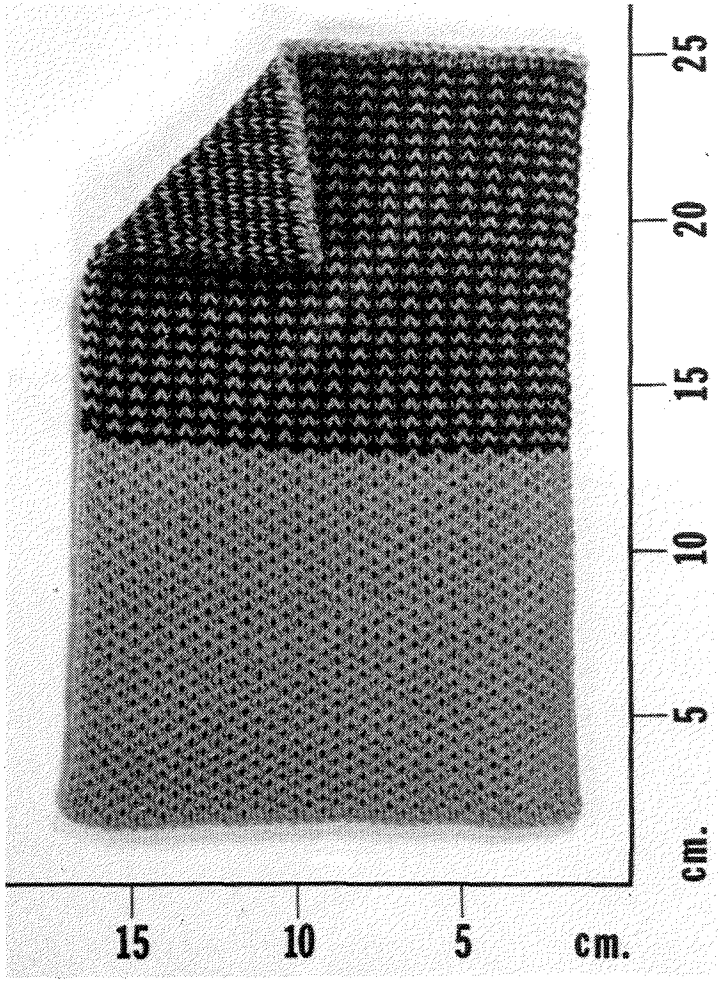
These fabrics are a combination of interlock rib and full needle rib. One bed knits full rib, the other knits interlock rib. Needle selection is on the interlock bed only. All machines can knit these fabrics easily. For Singer/Studio, use a 1x1 punchcard for interlock needle selection on the MB. For Passap, use pushers in 1x1 WP/RP. On Superba and Brother/Knitking, use the lili buttons on the front carriage.

RC2 makes one complete repeat, which is one rib row and one single bed row combined. All needles on the front bed and even needles on the back bed knit the first row (the rib row); odd needles on the back bed knit the second row (the single bed row), with slip stitch across the needles already knitted.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
French Pique	BX → push 1x1 WP/RP CX	o ↻ On MB only: Select odd ndls, RC1; *select even ndls, RC1;* select even ndls, RC1; select odd ndls, RC1.	part ↔ part N On MB only: Select odd ndls, RC1; *select even ndls, RC1;* select even ndls, RC1; select odd ndls, RC1.	o slip o o ← 1 On MB only: Select odd ndls, RC1; *select even ndls, RC1;* select even ndls, RC1; select odd ndls, RC1.



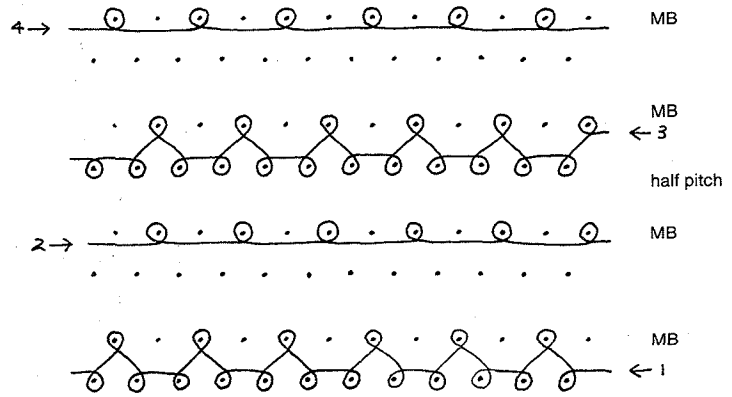
Combination rib.



French pique.

French Pique or Bird's-eye Twill

One row rib / one row single bed (RC2), on which the needles knitting are those which *slipped* on the rib row. In the next repeat, the needles which have just knitted the single bed row will knit again on the next rib row, so that 2 rib and single bed rows (RC4) are necessary to complete one full repeat. The two sides of the fabric are not identical. When knitted in two colors, there will be horizontal stripes on the reverse.

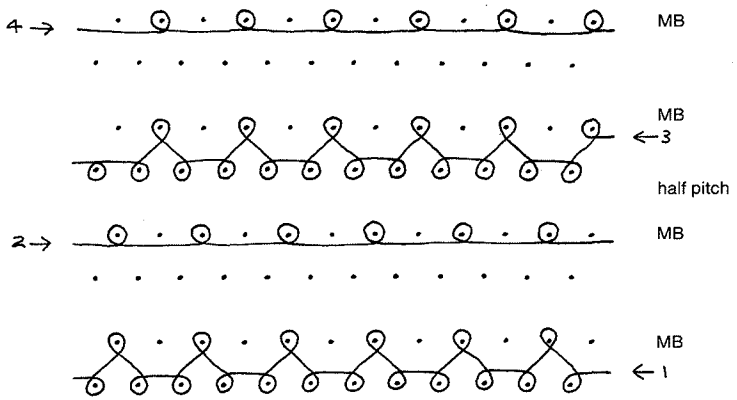


French pique.

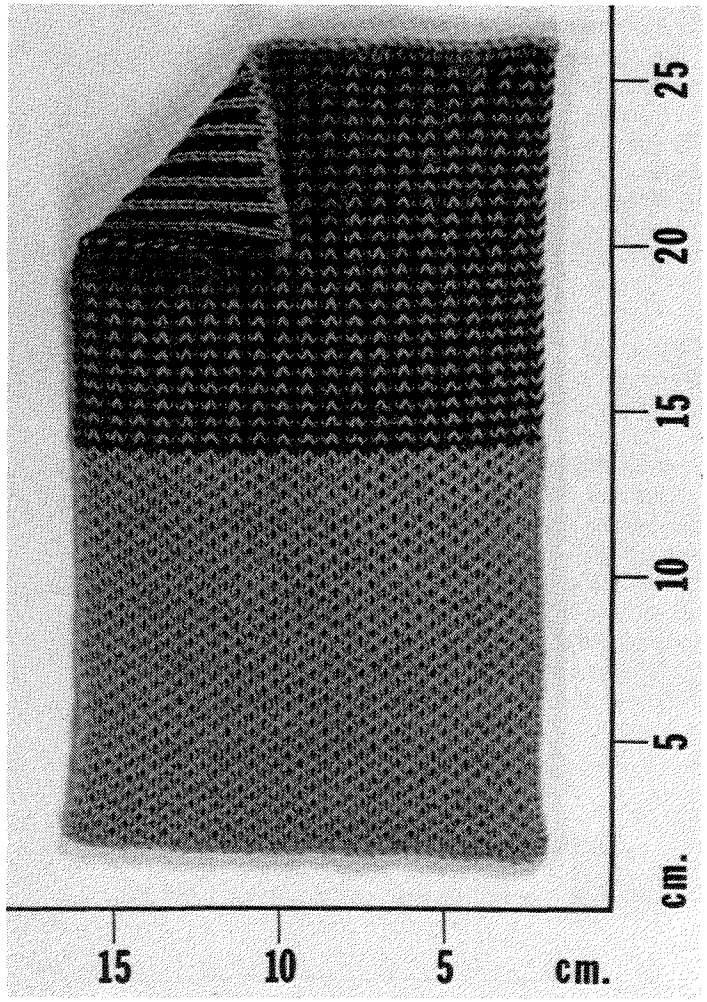
Swiss Pique or Overknit

One row rib / one row single bed (RC2) on which the needles knitting are the same ones which *knitted* on the rib row—exactly the opposite of the French pique method. In the next rib / single bed rows the needles which now knit are the ones which slipped in the previous repeat. Therefore, two rib / single bed rows (RC4) are necessary to complete one full repeat, as in French pique. The face of this fabric looks like French pique, both in one and two colors, but it is a little narrower. When two colors are used, there will be vertical stripes on the reverse.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Swiss Pique	BX ← push 1x1 WP/RP CX	o ↻ On MB only: Select odd ndls, RC1; select odd ndls, RC1; select even ndls, RC1; select even ndls, RC1.	part ↔ part N On MB only: Select odd ndls, RC1; select odd ndls, RC1; select even ndls, RC1; select even ndls, RC1.	o slip o o ← 1 On MB only: Select odd ndls, RC1; select odd ndls, RC1; select even ndls, RC1; select even ndls, RC1.



Swiss pique.



Swiss pique.

VARIATIONS

The variations are included to encourage you to experiment. Note that, except for color changes, most variations will loosen the fabric structure to some degree. You will be able to see the extent of this difference in your own swatches. If you experiment, choose the basic fabric which is easiest to do on your machine, then systematically put it through a series of changes such as those suggested below. Try not to change the basic alternating sequence of rib/stockinette rows, although you may want to alternate the needle selection differently, or change it to have all needles knitting to avoid an otherwise bothersome cam change or needle selection.

Some experiments will produce unexpected results, both good and bad; some will work with one kind of yarn but not with another. Here are some changes you might try:

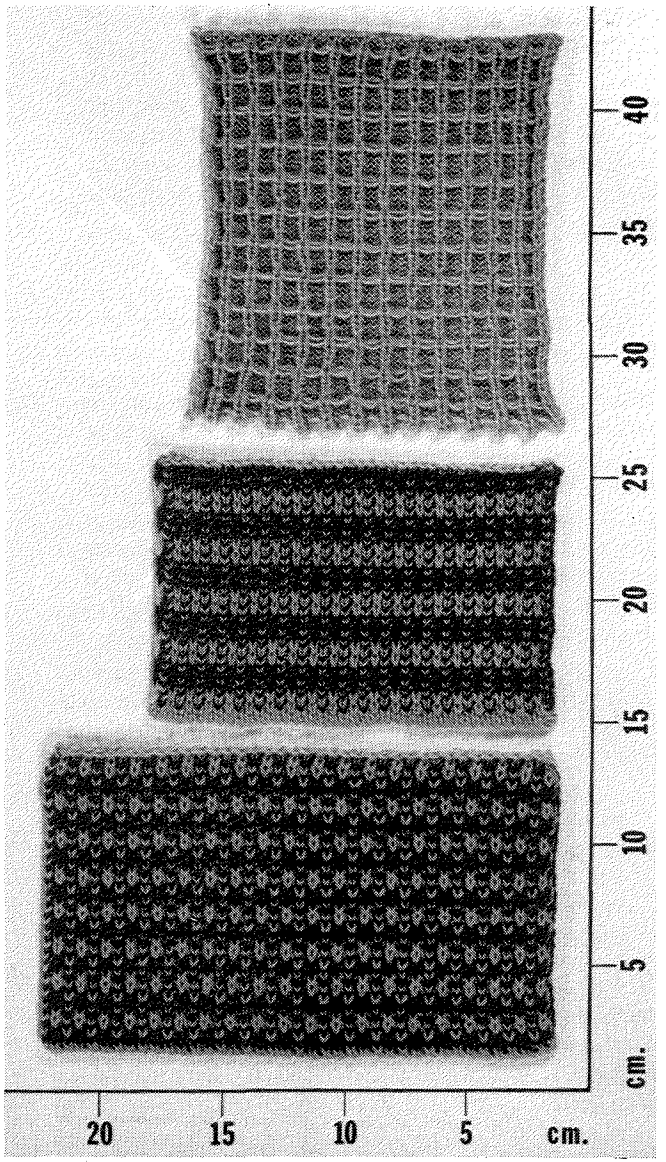
1. Use two or three colors, or two or three different types of yarn, changing every RC2 or RC4. Or alternate two rows of color 1 with 4 rows color 2.
2. Put a few needles on one bed into NWP.
3. Change one or both cams from slip to tuck.
4. On single bed rows, try a 1x1 knit/slip setting on rows where all needles knit, knitting two rows in knit/slip to one plain row.
5. Try racking, especially with a tuck cam setting.
6. When knitting fabrics based on interlock rib, try a 2x1 or 2x2 needle selection instead of 1x1.

The following photos illustrate a few variations to show what can happen with even one or two changes.

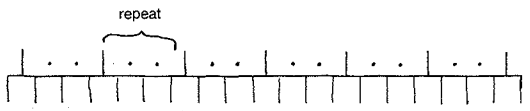
Milano waffle. One color. On one of the beds, two needles out of three are in NWP to make vertical ribs. Cams are set the same but the knitting sequence is doubled. RC4 full needle rib / RC4 tubular.

Milano Rib variation. Rib row is the same as for Milano rib (RC1). Tubular row is knitted twice (RC4) with alternating 1x1 needle selection, knit/slip, on both beds. RC2 each color.

Tucked pique. Knitted exactly like the basic pique swatch in 2 colors, but with cams set for tuck. Be sure that one cam is changed to slip or free move for the single bed rows, otherwise the needles on the opposite bed will all take tuck loops. Set beds at half pitch.

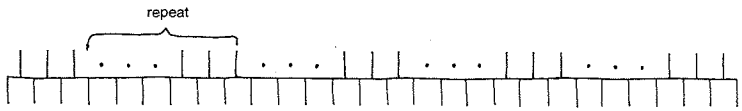


Top. Milano waffle.
Center. Milano rib variation.
Bottom. Tucked pique.

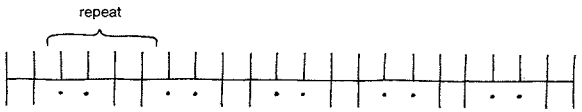


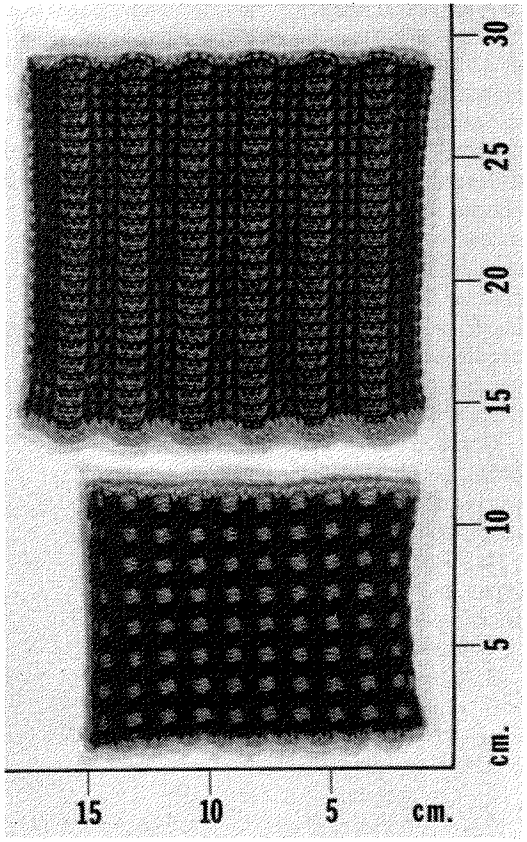
Milano waffle.

Half Milano with tucked Long Stitch. The second bed knits the same as Milano rib. The MB (knitting the Long Stitch) has some needles in NWP for an embossed rib. These rib needles tuck one row, then slip one row, with color 1 while the second bed knits both rows. Then the rib needles knit one row, then slip one row, with color 2 while the second bed knits both rows.



Windowpane bourrelet. The needle set-up on the second bed (with single bed rows) remains the same as in basic bourrelet. The needle set-up on the MB is *2 ndls in WP, 2 ndls in NWP.* Repeat. Beds are at full pitch. Needle selection on both beds is in the same alternating sequence as for basic bourrelet, and cam settings are the same. Knit RC6, col 1, with first half of the knitting sequence; RC6, col 2, with second half of the knitting sequence.

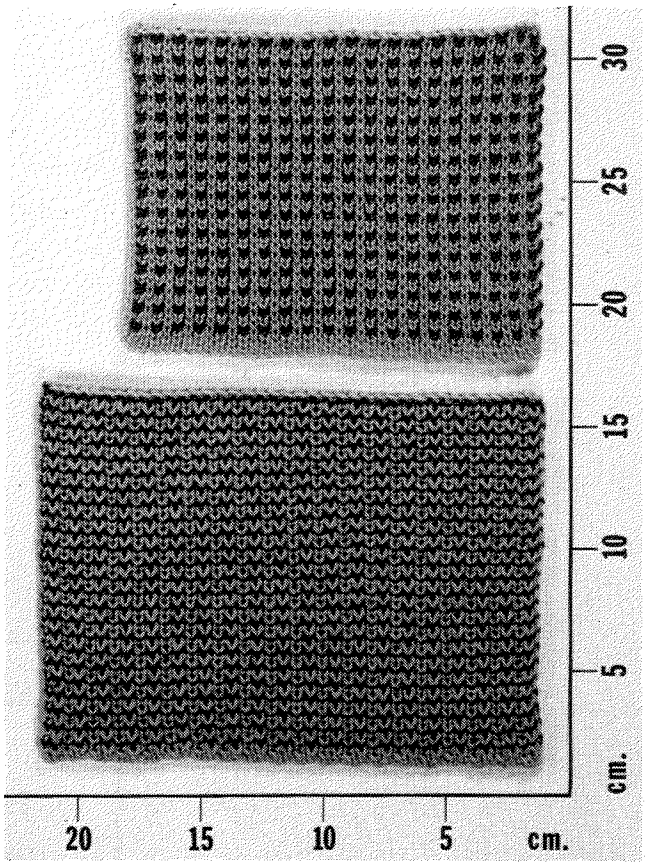




Top. Half Milano with tucked long stitch.
Bottom. Windowpane bourrelet.

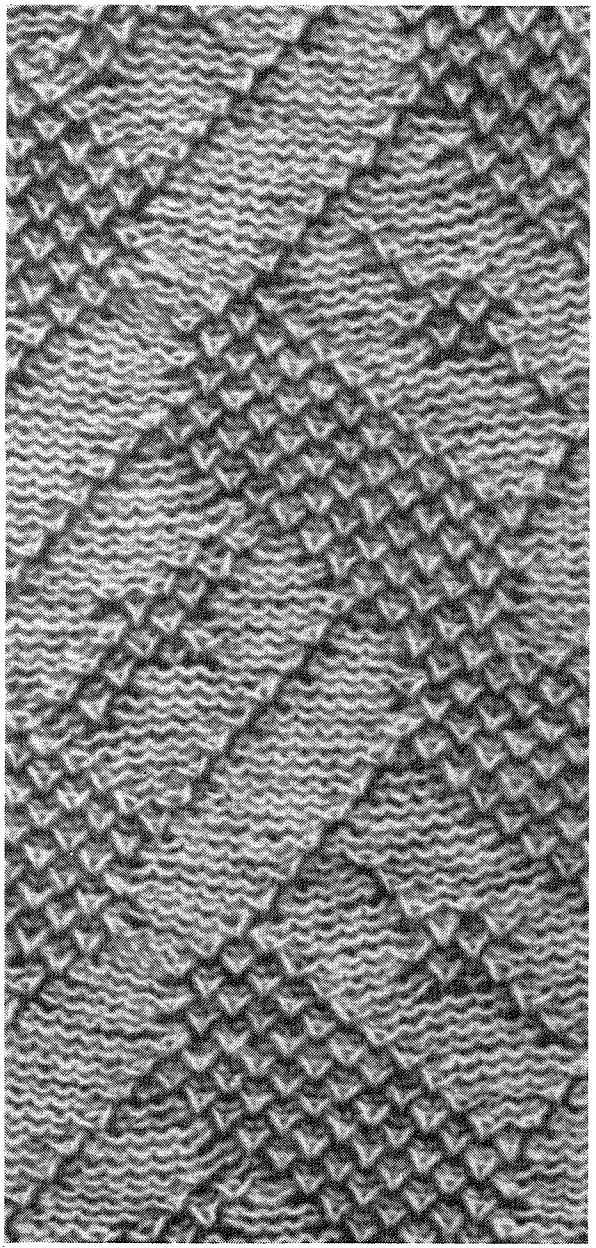
Triple knit rib variation. This is the same fabric as the basic triple knit rib, with more rows added to even out the color repeat. Two rows are knitted in rib (RC2) with col 1, and two rounds knitted in tubular (RC4) with col 2.

Evermonte with Fisherman's Rib. This one is knitted as the basic Evermonte in two colors, except for the cam settings on the two rib rows. Row 1 is plain knit on one bed and knit/tuck on the other. Row 2 reverses the cam settings (col 1). The tubular row is the same (col 2).



Top: Triple knit rib variation.
Bottom: Evermonte with fisherman's rib.

CHAPTER 7
Plating



The plating technique makes possible certain effects in a knitted fabric which can't be achieved any other way. In plating (sometimes *plaiting* or *platting)* two different yarns are knitted simultaneously in such a way that one yarn covers or "plates" the other as the stitches are formed. The resulting fabric shows one yarn on the face and the other on the reverse. When yarns of unequal weight are used, the heavier will show as a solid color on one side, while the other side will show the thinner yarn backed by the heavier. When two yarns of equal weight are used, they almost cover each other on both sides of the fabric. The following are situations in which plating is a particularly suitable technique.

You can make a reversible fabric with two totally different kinds of yarn, perhaps in different colors and textures. One color and texture will show on the face of the fabric and the other on the reverse.

Plating gives body to a very thin yarn such as fine mohair or boucle, or space-dyed yarn (where using two ends would mar the pattern), because you can combine it with another yarn of the same or a different color.

Elastic thread can be incorporated for shirring or gathers.

Plating can be used to reinforce stress points, such as the elbows on sweater sleeves, the knees of pants, and the heels and toes of socks.

Two colors can be used in single and double bed stitch patterns where knitting in two colors would otherwise be difficult or impossible.

Both single and double bed fabrics can be knitted with plating; embossed techniques are particularly effective in double bed, while lace and tuck stitch patterns can be striking in single bed. No special cam settings are necessary, but a special feeder on the carriage is necessary to feed the yarn to the needles in such a way that the two yarns don't mix. Superba, Brother/Knitking, and Singer/Studio have feeders for both single and double bed plating, while Passap has no feeder at all. Plating *can* be done on Passap, but the results may not be perfect.

The three machines with feeders differ in their plating capabilities because of the differing designs of their feeders. Following are the particular capabilities of each.

PLATING FEEDERS

Brother/Knitking. Single bed plating is possible on the main bed or ribber, double bed fabrics can be plated on both beds. On the main bed, using the sinker plate for single bed knitting, the plating feeder is an accessory which must be mounted on the sinker plate in place of the usual A and B feeder unit. The two yarns are placed in separate openings: one in the main feeder and the other in the plating feeder, which is a slot behind the main feeder. The two yarns can exchange places without being cut, or either one may be exchanged for a different yarn. The yarn in the main feeder will appear on the knit side, and the yarn in the plating feeder will appear on the purl side of the fabric. Plating can be done this way in stockinette or with punchcard patterning.

The ribber arm also has an accessory plating feeder which replaces the usual yarn feeder. It also has two slots for the two yarns, which can exchange places without being cut and rethreaded. With this feeder, you can plate in stockinette on either the main bed or the ribber, or in any double bed fabric which does not involve the use of the color changer. The yarn in the main feeder will show on the knit side and the yarn in the plating feeder will show in the purl stitches of both beds, regardless whether the fabric is in stockinette or rib.

Singer/Studio. Single bed plating can be done on the main bed or ribber; double bed fabrics can be plated on the ribber bed only.

On the MB, using the sinker plate for single bed knitting, the plating feeder is a slot located behind feeder 1. One of the yarns must be threaded through it (and cut and rethreaded if you want to change yarns). The other yarn is put into feeder 1 and can be removed or changed without cutting. The yarn in the plating feeder will show on the purl side of the fabric; the yarn in the main feeder on the knit side. Plating by this arrangement can be done in stockinette or with punchcard patterning. Plating can also be done without the plating feeder, in stockinette only, by placing the two yarns in feeders 1 and 2 and setting the cams for punch lace. Lock the card lever (don't use a punch-card), and pull the side levers forward. The two yarns can easily be switched to exchange places without

cutting. By using pattern cards with the punch lace setting (side levers back), you can make fabrics with some interesting textures.

The slot for the ribber plating feeder is located on the ribber arm (it is labeled "P") and must be pushed forward into position. The yarn for this feeder is threaded (and cut and rethreaded when changed) the same as for the plating feeder on the MB sinker plate. The other yarn goes into the main feeder on the ribber arm and may be taken out and changed. You can use the color changer to change the yarn in this feeder; pull the yarn in the P feeder toward you and out of the way when changing colors. In single bed work on the ribber, the yarn in the main feeder will appear on the knit side of the fabric, and the yarn in the P feeder on the purl side. In double bed work, the yarn in the main feeder will cross back and forth between the beds as usual; however, the yarn in the P feeder will plate only on the purl side of the stitches on the ribber needles, and will not cross to the MB. If any needles are left out of work on the ribber bed, the plating yarn will form floats across the empty spaces.

Superba. Single and double bed plating can be done in two different ways, but only on the front (second) bed. The first method uses either the Direct or Reverse plating accessory, which is fastened to the carriage by a bar (all of this is part of the PTV accessory). One of the yarns is threaded through the attachment, and must be cut and rethreaded if a yarn change is called for. The other yarn goes into the main feeder on the carriage. It also must be cut and rethreaded for a yarn change, because the bar for attaching the plating feeder prevents easy switching of the yarns. If the Reverse plating feeder is used, the yarn in the main feeder will appear on the knit side and the yarn in the plating feeder on the purl side. With the Direct feeder, it is just the opposite. The openings for threading the yarn on these attachments are very small and suitable for fine yarn only. If coupled with a medium or heavier yarn, that yarn should always be placed in the main feeder. One advantage of these attachments is that they produce nearly perfect plating. They also allow you to incorporate short rows, which cannot be done in the method described below. With either of these feeders, the same principles which apply to double bed plating on Singer/Studio apply to Superba as well: the yarn in the main feeder will knit on both beds as usual, while the yarn in the plating feeder will knit only on the needles of the front bed, and won't cross to the needles of the main bed.

The second method uses the double yarn guide, the attachment used for two-color jacquard knitting. With this method, yarn positions can easily be switched in the double feeder. Also, the jacquard cam setting on the back carriage, coupled with needle selection on the main bed, can be used for patterning in two-color, double bed embossed work. This technique is the same as that used for rib jacquard with plated backing, described in the Superba Specials section of Chapter 1. In both single and double bed work, the yarn in the main feeder will show on the knit side and the yarn in the double feeder on the purl side of the stitches on the front bed only. This yarn knits on the main bed only when there is jacquard selection for it. However, this kind of patterning is not plated on the main bed, as on Brother/Knitking, but knits only as jacquard.

Either of the above methods can be used for single bed work in stockinette, but the knitting and plating are always on the front bed. Patterning in single bed knitting is limited to 1x1 needle selection (using the lili buttons) or manual needle selection, as the selection box does not operate on the front bed. Patterning can be in either slip or tuck stitches (with no jacquard key). Good suggestions for patterns using the lili buttons can be found in the instruction book.

TECHNIQUES FOR PLATING

1. The two yarns used in plating are usually of unequal thickness. It is best to combine a medium weight with a lightweight yarn, or a lightweight yarn with a very thin one, to avoid excessive bulk or hardness in the finished fabric.

2. Smooth, well-waxed yarns give the best results. They are less apt to stick together and mix during stitch formation. If a rough yarn, such as mohair, is used, then the other yarn should be very slick, like rayon or glossy cotton.

3. Put the two yarns in separate tension arms, with greater tension on yarn in the plating feeder.

4. Use more weights than usual to prevent problems which stem from yarns mixing.

5. Make the stitch size one-half to two sizes larger than usual. Remember that two yarns are knitting simultaneously and the needles must hold both yarns together, hence the stitch size must be large enough to accommodate both.

6. Knit more slowly than usual, and with a steady rhythm, to prevent changes in yarn tensions. Plating is not for speed demons!

7. There are no special cam settings for plating. Use the usual cam settings for the fabric you plan to knit.

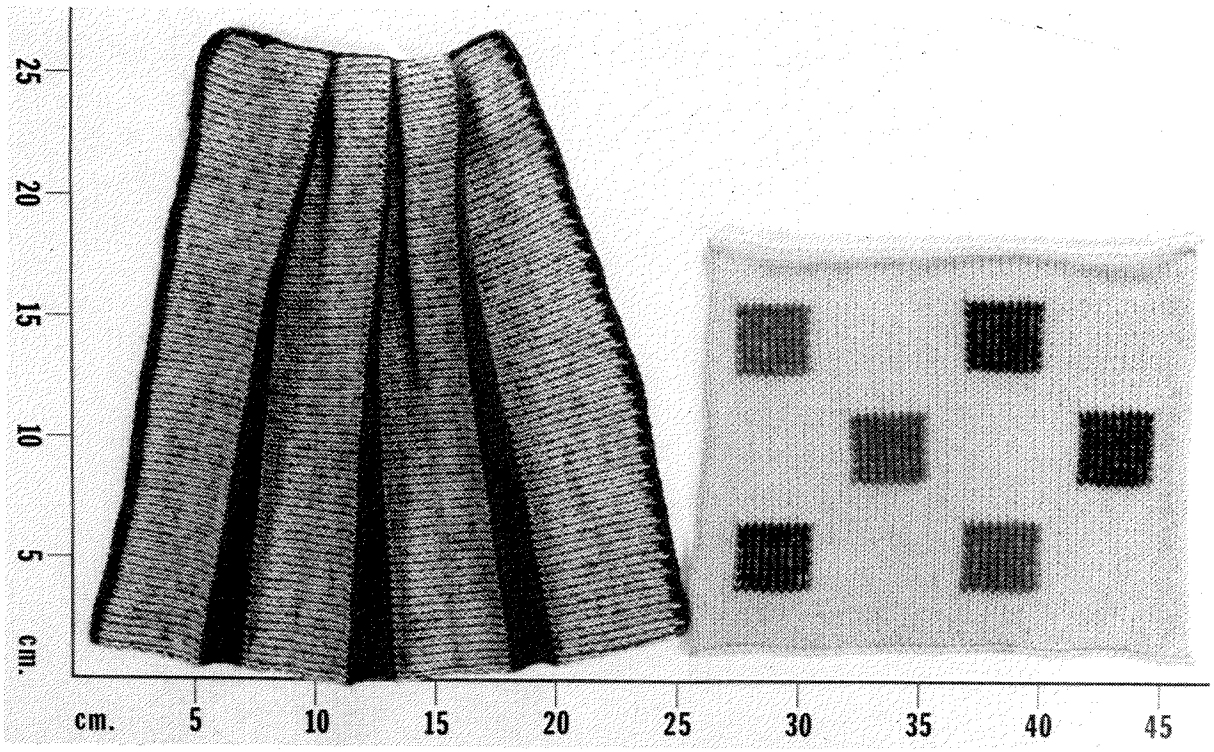
8. If you want part of your knitting to be in one color, without plating, simply remove the yarn you don't want. The other yarn can knit alone, no matter which feeder it is in. A yarn which knits alone need not be in the main feeder.

9. On machines without a plating feeder, such as Passap, it is best to use a medium weight yarn coupled with a lightweight one. Both yarns must be placed in the feeding eyelet together. With one hand held just above the feeding eyelet, separate the two yarns so that one always passes in front of your hand and the other behind. Pull gently on the yarn in front, as it passes into the feeding eyelet to help control yarn mixing.

PATTERNING IN PLATING

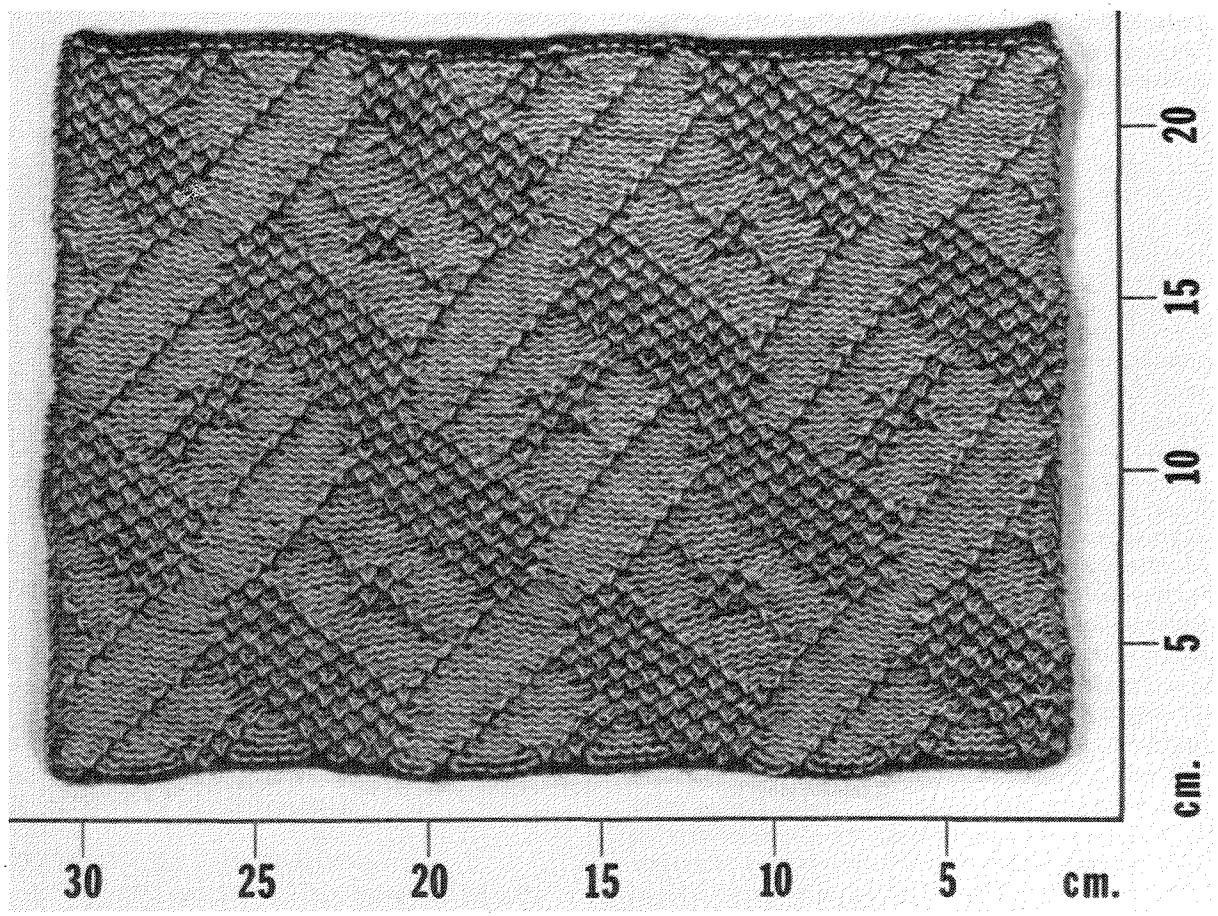
Single bed fabrics. As has already been pointed out, either yarn can show on either face of the fabric, depending how the two yarns have been threaded in the feeders. It is handy to be able to switch them, for making stripes or to remove one of them and allow the other to knit alone. (It is usually more convenient to remove the one in the main feeder.) The rows knitted with one yarn will be thinner in weight than the ones knitted with both yarns. This technique is very suitable for pleats, shadow ribs, and similar work. The illustrated swatch of pleated fabric knitted sideways shows how a thicker fabric—the plated overlap of the pleat—can be combined with a thinner fabric—the non-plated underlap of the pleat—by removing the yarn in the main feeder on the underlap rows. This swatch was knitted in stockinette and can be done on all three machines with single bed plating feeders. Along the same line, motifs, charted first on graph paper, can be made with an intarsia technique by placing the motif yarn in and out of the main feeder at specified points on the same row. The yarn for the main fabric would remain in the plating feeder throughout.

The following three photos show single bed fabrics knitted with a combination of 1 yarn and 2 yarns, either on the same row or on successive rows.

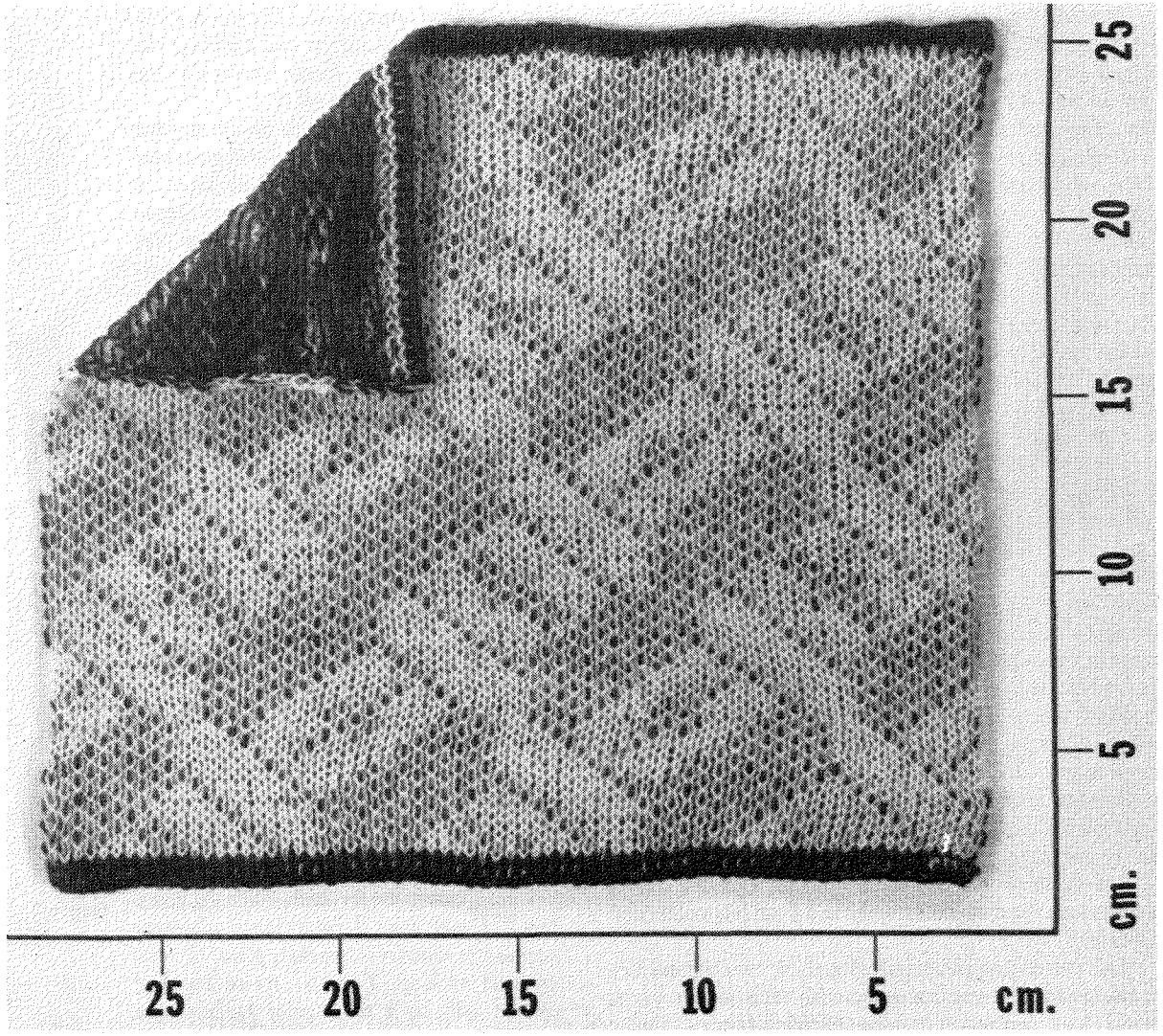


Left. Pleated fabric knitted sideways. Medium weight yarn in the plating feeder (dark); fine weight yarn in the main feeder (light). Knit 20 rows with both yarns at a larger SS, then 10 rows with dark yarn alone at a smaller SS, for each repeat. In this swatch, the pleats have been folded and blocked.
Right. Motif knitted in an intarsia technique (tapestry knitting, method 2, described in the Intarsia chapter). Medium weight yarn (light) in the plating feeder is the main yarn. It remains in this feeder throughout the knitting. Square motifs are fine weight yarn (the 2 dark colors). Each square has its own ball of yarn, which is placed in the main feeder only during the time that its ndls are knitting. Each square is 9 sts wide and 12 rows in length.

Tuck and slip patterns can be knitted on Brother/Knitking and Singer/Studio with punchcards. This one is jacquard Pattern 2, in tuck stitch, EOR rotation. Tuck or slip patterns can also be knitted on Superba on the front bed, using manual ndl selection or lili buttons.



On Singer/Studio, you can create softly textured fabrics of various transparencies by using feeders 1 and 2 with the punch lace setting and a punchcard (jacquard Pattern 2). The yarn in feeder 1 (dark) is medium weight; the yarn in feeder 2 (light) is finer weight.



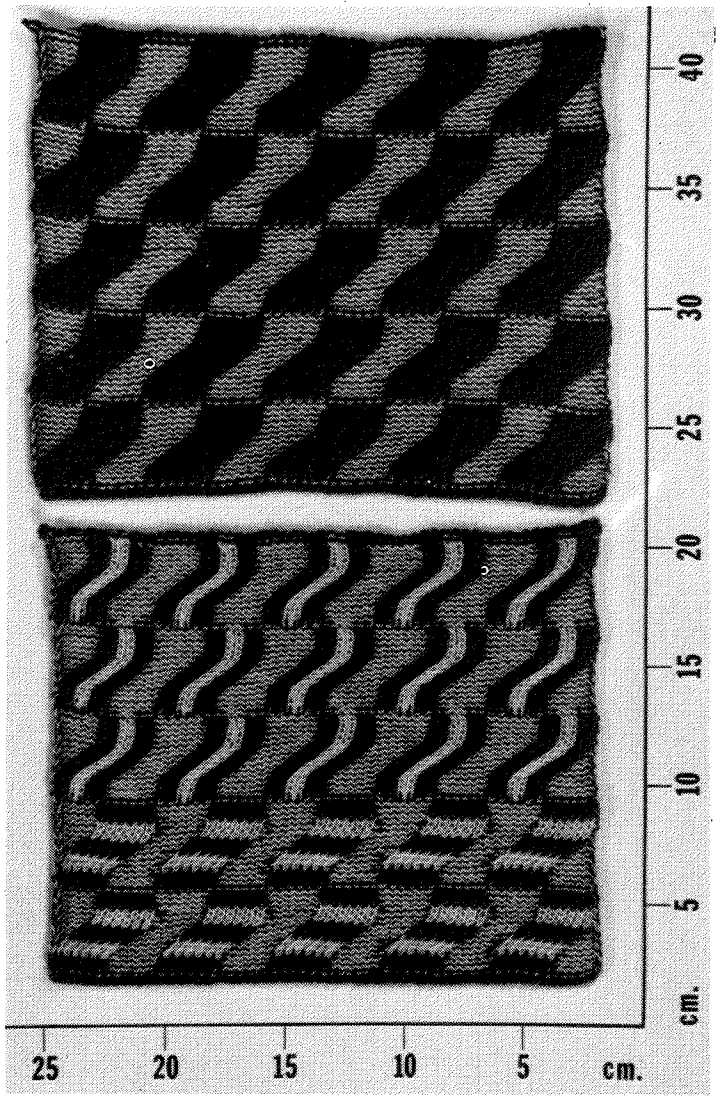
Double bed fabrics. Some double bed fabrics can be very effective knitted with plating. Almost any fabric (except rib jacquard knitted in FNR set-up) would be a good candidate for this technique. Below are two examples.

Embossed patterns. Have all needles knitting on the front bed, coupled with selected groups of needles knitting on the back, or main, bed for the embossed pattern. The yarn in the main feeder will show in the knit stitches of both beds, while the yarn in the plating feeder will show in the purl stitches of the front bed, and will contrast sharply with the embossed pattern made on the back bed. Ribs—straight or racked, tucked or cabled, in one or two colors—and cross-bed transfer patterns are all very effective against a plated background.

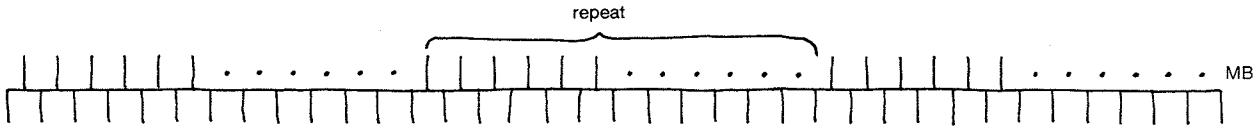
Knit/purl ribs. Opposite groups of needles are in working/non-working position on both beds. The yarn in the main feeder shows in the knit stitches of both faces. On Brother/Knitking, the yarn in the plating feeder will show in the purl stitches of both beds as well, resulting in a reversible fabric. On Superba and Singer/Studio, however, the plating yarn does not cross to the MB and makes a float across the front bed needles in NWP instead. The floats can be hooked over a convenient needle every few rows for additional patterning detail if desired. In narrow ribs, such as 1x1, 2x1, and 2x2, the color effect is the same in fabrics made on all three machines, although the actual structure is the same as in the wide ribs. There will be fairly normal stretch across the width, but the fabric will be vertically striped in two colors. This is a handy way to knit the two-color welts in a Fair Isle patterned sweater.

The patterning potential with these two techniques is extensive, and when coupled with variations in yarns and colors, can result in some exciting fabrics. Those shown in the photographs are very simple and are just a start. Swatches knitted with plating are illustrated in several other chapters, particularly Pile, Embossing, and Lace.

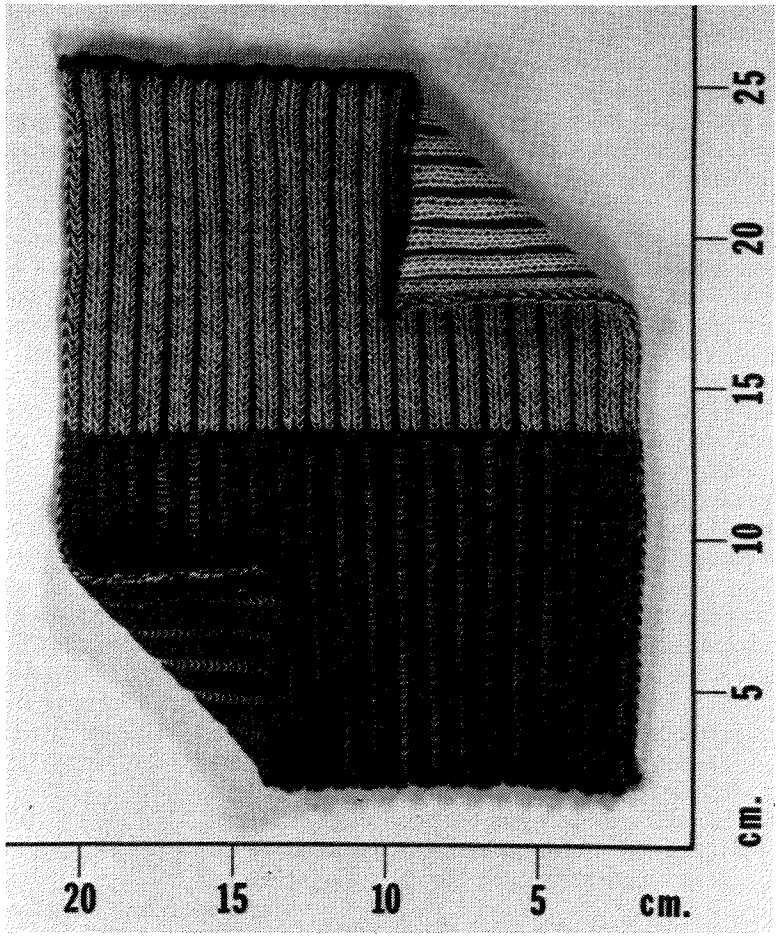
Top. Embossed racked rib. The yarn in the main feeder knits both rib and backing; the yarn in the plating feeder shows on the backing only in the purl sts.
Bottom. Same rib pattern as above, knitted on Superba using the double yarn guide and jacquard cam setting on the back carr. A similar fabric can be knitted on Singer/Studio using rib jacquard with striper backing (described in the Jacquard chapter), with punchcard Type B or C. The yarn in the plating feeder can be a third color, if desired. With this pattern a card is not really necessary for ndl selection; manual selection with a pattern ruler would not be difficult.

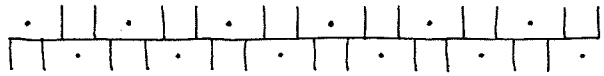


*Rack 3 ndls L or R of center before setting up. Set both carriages for knit. Knit 10 rows, *rack 1 ndl, knit 2 rows* until alternate position is reached (6 racks). Knit 10 rows without racking. Transfer sts to backing; rack 6 ndls back to original position and repeat the entire sequence.*



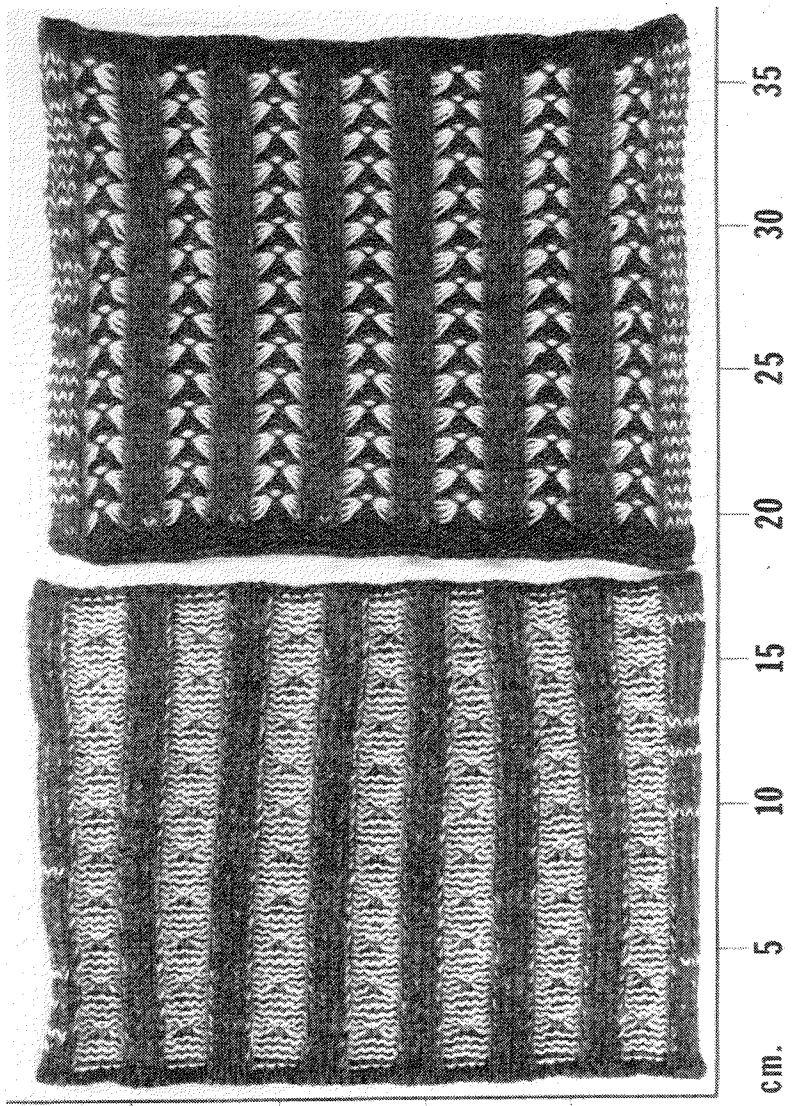
2x1 rib (2x2 industrial rib), with yarns reversed midway.

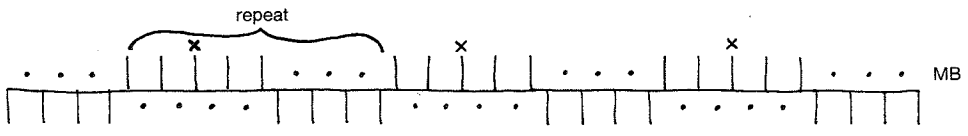




Top. Wide rib with floats, knitted on Superba or Singer/Studio. Floats are hooked over the center ndl of the opposite bed (x) every 4 rows. Both carriages set for knit.

Bottom. The same wide rib knitted on Brother/Knitking. Since there are no floats, the center ndl each rib on the MB (x) tucks every 5th and 6th rows (put ndl in HP). Both carriages set for knit.





CHAPTER 8
Pile Fabrics

Pile, also known as *loop stitch* or *carpet stitch,* is a relief fabric made on a double bed machine. It is a kind of release or dropped stitch fabric in which the needles of one bed form loops on empty needles, which are released or dropped immediately after they are made, while the opposite bed makes the backing that holds the loops in place.

When the loops are short and are made every row the fabric has a dense, closely packed carpet-like surface. The loop rows can also be spaced with plain knitting in between, and the loops themselves can be made different lengths (or heights) to create a sculptural design in horizontal stripes. Or punch-cards can be used to select groups of needles to knit embossed and two-color pile patterns, known as "punch pile."

Each machine makes pile in a slightly different way, depending whether or not it has a pile attachment or a plating feeder for double bed. Some pile knitting techniques can be done easily on all the machines, some on only one or two. There are two basic methods of making pile fabrics: with one yarn, or with two yarns knitting in a plating relationship. Each method has variations. Before starting to knit, consult your instruction book for the use of special attachments your machine may have for knitting pile.

TECHNIQUES FOR KNITTING PILE FABRICS

1. Cast on or transfer all previously knitted stitches to the bed making the backing before starting the pile pattern, to prevent the dropped pile loops from dropping all the way through any previous knitting on that bed.

2. Use a smooth acrylic or wool yarn with good compressibility to ensure success, but don't be afraid to experiment with other yarns to achieve different effects. Begin with high quality, plain yarn in fingering or sport weight. If you use the plating method, combine this yarn with a finer one in the same color or in a different color. With heavier yarns, knit the loops EOR; with finer yarns, knit them ER. To ensure that the loops are always released cleanly, use a single end of yarn rather than two or three ends together.

3. The beds are always set at half pitch. Have one more needle working on the backing bed than on the loop bed, because each loop requires a needle on either side of it on the backing bed to hold it in place. If your design calls for a selvedge with no loops, then leave two or three needles in NWP on each end of the loop bed.

4. The SS and bed spacing on the loop bed depend on the yarn size and the length of loop you want. Be sure all loops will be released with one pass of the carriage; if the loops are too big or the yarn too fuzzy, they won't all fall off. In plain pile, one or two hanging loops can be brushed apart after the knitting comes off the machine, but in pattern work, all the loops *must* be released with every pass of the carriage. The SS for loops is usually quite small, from 1½ to 3. Adjustments in bed spacing can be made on all machines except Passap to allow larger loops to be knitted and released easily with the same SS.

The backing stitches, for the type of pile knitted with one yarn, must be tighter than usual to hold the loops firmly in place, but not so tight that the fabric becomes hard or curls excessively.

For pile knitted with two yarns, remember that on the backing two yarns are knitting at once, so the stitch size must accommodate both yarns yet still be firm enough to hold the loops tightly. Thread the two yarns in separate tension arms. The tension of the plating yarn should be greater than that of the pile yarn.

It is very important to block your swatch before making a final decision about the stitch size. A backing which may seem very tight may be much more relaxed after blocking.

5. Extra weights must always be used, even on Passap. They ensure that the tight backing stitches will knit more easily, and the loops will be released more cleanly.

6. Use simple, bold designs in punch pile. They enhance the sculptured effect of the pile better than do intricate patterns. There will also be less danger of ruining the design through snagging. In one-color designs, the design tends to compact vertically, so there should be two consecutive rows of loops knitting the same pattern row. In two-color work,

only one row of loops is needed for each color in the pattern row because the design expands vertically.

7. For cut pile, bend the fabric back along a vertical column of loops and cut them all the way up. Cut pile doesn't snag as easily as loop pile.

8. In the embossed and punch pile techniques, it is necessary to release the loops every pattern row. In plain pile and two-color pile, the loops can be released and unravelled after the knitting is completed, if desired. The latter has two advantages: longer loops can be made by using a larger stitch size on the loop bed, and some of the stitches can be left ravelled (knitted) to make another type of embossed pattern. The swatch of the white square pattern, shown toward the end of this chapter, illustrates this technique, which can be done on any machine. This one is in two colors, but it could be made in one color plain pile. Do not use a fuzzy yarn or unravelling will be very difficult.

9. Pile has one inherent disadvantage: it is prone to snagging. One good pull or catch can suddenly remove a whole row of loops, especially if the pile is made with one yarn knitting both loops and backing. Thought should be given to how and where a pile fabric will be used, and to the yarn with which it will be knitted. A yarn with good compressibility makes a nice, dense pile with a firm backing, which will lessen the tendency to snag. Application of rug latex to the back of the finished fabric further reduces this tendency. It doesn't add stiffness, and it can be washed or dry cleaned. If it is used on a garment, the garment should be lined to prevent discomfort from the rubbery feeling of the latex.

10. All directions given in this chapter are for loops to be made on the main bed, and backing on the second bed, unless otherwise noted.

TWO METHODS FOR KNITTING PILE

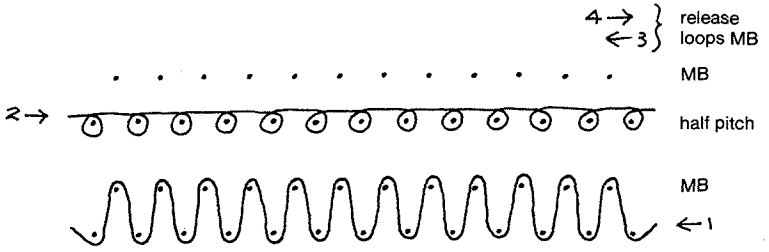
There are two basic methods for knitting pile, described under Plain Pile, below. The other pile fabrics described in this chapter are knitted by using variations of these methods.

Plain pile, with one yarn knitting both backing and loops.

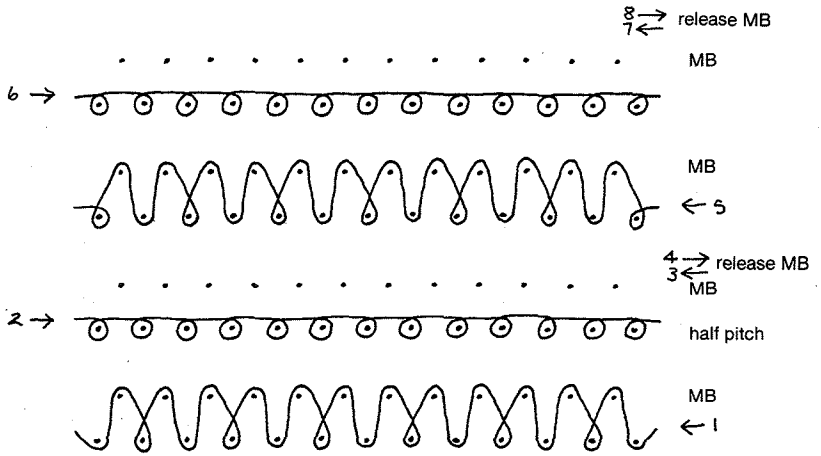
This is the standard method of knitting pile on Passap and Brother/Knitking, but it can also be used on Superba and Singer/Studio. Two rows of knitting are required for each row of loops. On the first row, the stitches are zigzagged (or tucked) across the needles of both beds. The needles on the main bed will have been empty. On the second row, stockinette is knitted across the second bed only to form the backing that holds the loops in place. In the third and fourth rows, the single row of loops formed on the main bed is released with an empty carriage (uncoupled), a pattern ruler, or accessory attachment.

There is a variation of this method, which is used principally for punch pile. Alternating needles (1x1) on the second bed knit/tuck on the first row, while the main bed takes new loops as described above. The second, third and fourth rows also are the same as above. In the next sequence, the knit/tuck needles on the backing alternate from the previous sequence. The needle selection in the backing causes the pile loops to angle diagonally in pairs, as can be seen in the photograph at right.

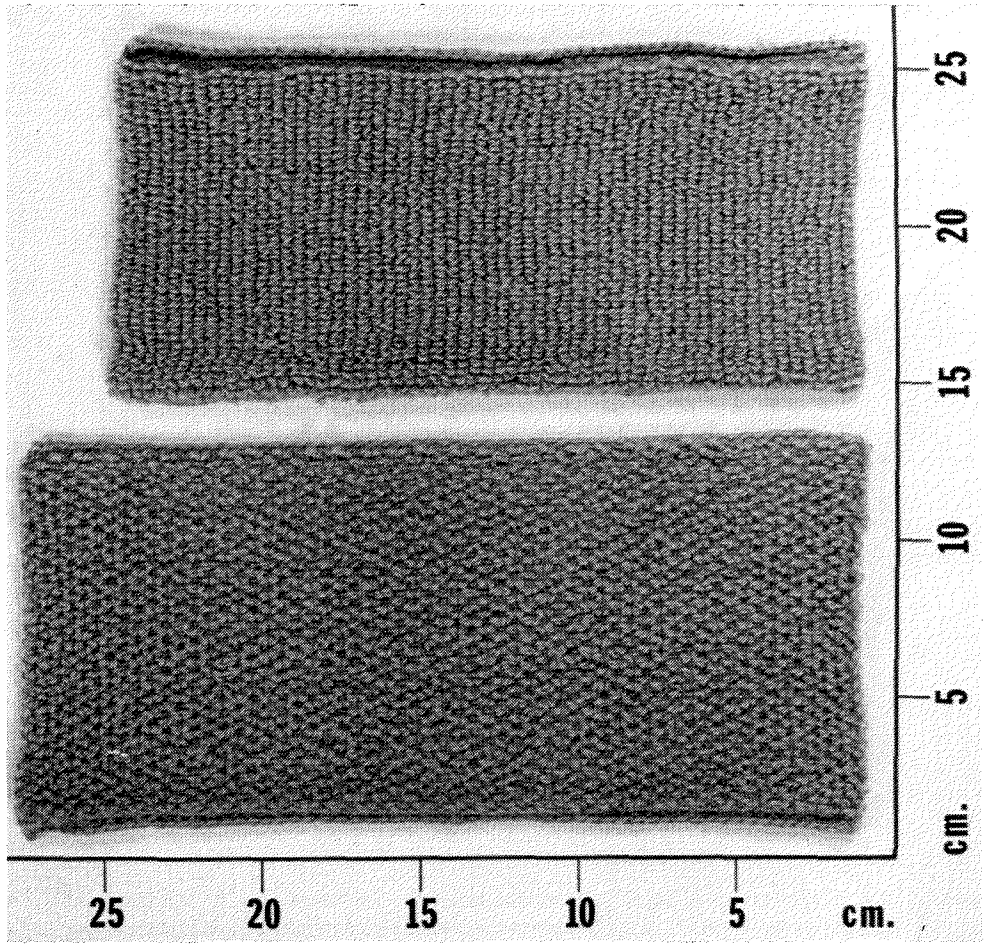
	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Plain Pile 1 color plain backing	EX / CX RC2 both carr; RC2 front carr to release loops.	C / ⊃∩ RC2 ea sequence pile attachment	tuck → / part N CO MB; loops on ribber. RC2 both carr; RC2 ribber carr to release loops.	△ tuck o / o ← 1 CO MB; loops on ribber. RC2 both carr; RC2 ribber carr or P carr to release loops.
Plain Pile 1 color 1x1 backing	FX ← push 1x1 WP/RP / CX RC2 both carr; RC2 front carr to release loops.	C / ⊃∩ RC2 ea sequence FB: select odd ndls, then even ndls, EOR. pile attachment	tuck → / part N 1x1 card from basic package CO MB; loops on ribber. RC2 both carr; RC2 ribber carr to release loops. MB: select odd ndls, then even ndls, EOR.	△ tuck o / o ← 1 1x1 card from basic package CO MB; loops on ribber. RC2 both carr; RC2 ribber carr or P carr to release loops. MB: select odd ndls, then even ndls, EOR.



Plain pile, with one yarn knitting both backing and loops. Extra needle on backing.



Variation on plain pile (above), used principally for punch pile. Extra needle on backing.



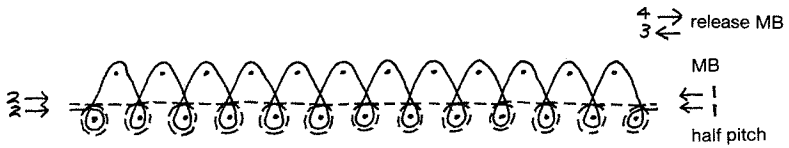
Top. Plain pile made on all machines. Made with a single yarn.
Bottom. Plain pile with 1x1 knit/tuck on the backing, made on all machines. Made with a single yarn.

Pile made by two yarns in a plating relationship.

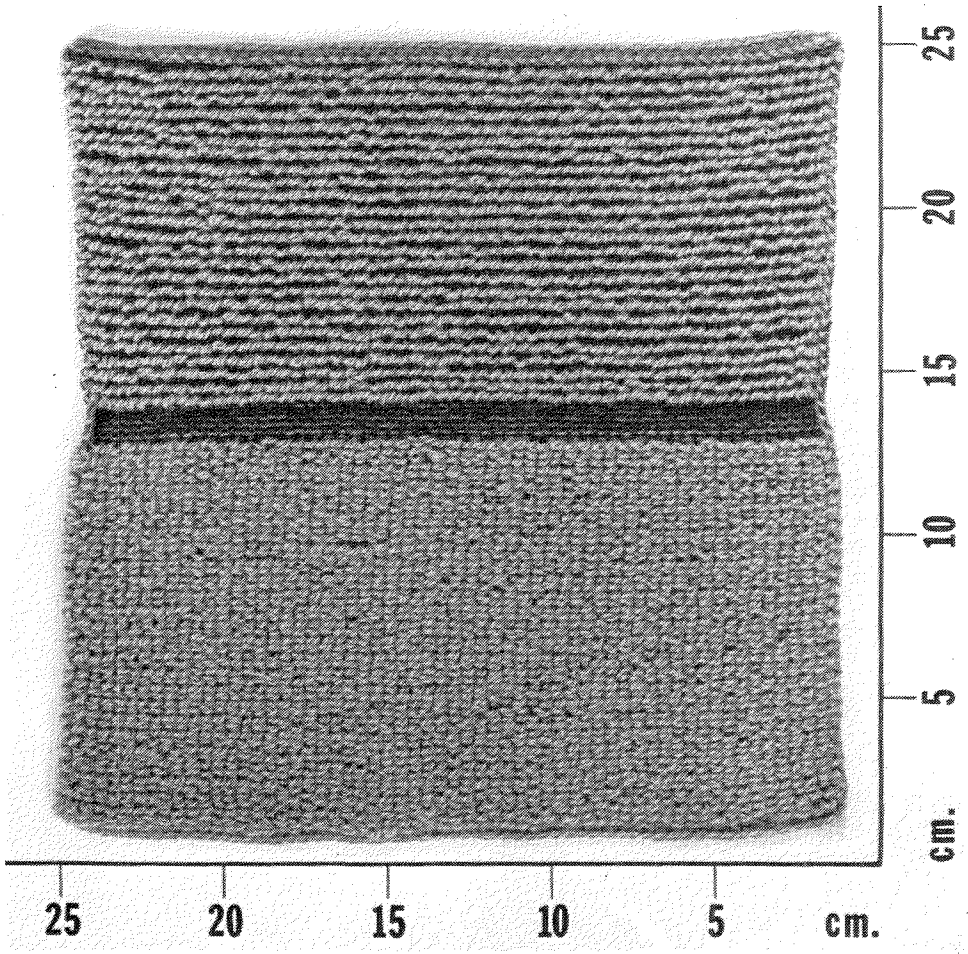
This method is used on Superba and Singer/Studio machines, which have plating feeders for double bed work. It cannot be used on Passap, or on Brother/Knitking. (The plating feeder on the Brother/Knitking ribber causes both yarns to knit on both beds, which precludes its use for pile of this kind.) Because two yarns are used, this method lends itself to interesting two-color work.

The main color yarn, in the main feeder, knits both backing and loops. The second yarn, in the plating feeder, is at the same time knitting in a plating relationship on the second bed only. Just one row of knitting is required for each row of loops. The pile loops are formed and released as in the single-yarn method, but the backing is entirely in stockinette, with the plating yarn holding the loops in place, and showing through the loops against the purl stitches of the backing.

	Passap carr R	Superba carr R	Brother/Knitking carr L	Singer/Studio carr L
Plain Pile 1 color plated backing		$\frac{\wedge}{\wedge}$ loops ER - carr L or R $\frac{C}{\wedge}$ loops EOR - carr R RC2 each sequence MC in main feeder; plating yarn in DYG or either plating feeder. pile attachment		$\frac{\triangle \text{ slip } \triangle}{1 \leftarrow 1}$ loops ER $\frac{o \text{ slip } \triangle}{1 \leftarrow 1}$ loops EOR RC1 or 2, release loops MB with P carr. MC in main feeder, plating yarn in P feeder.



Pile made with two yarns in a plating relationship. Extra needle on backing.

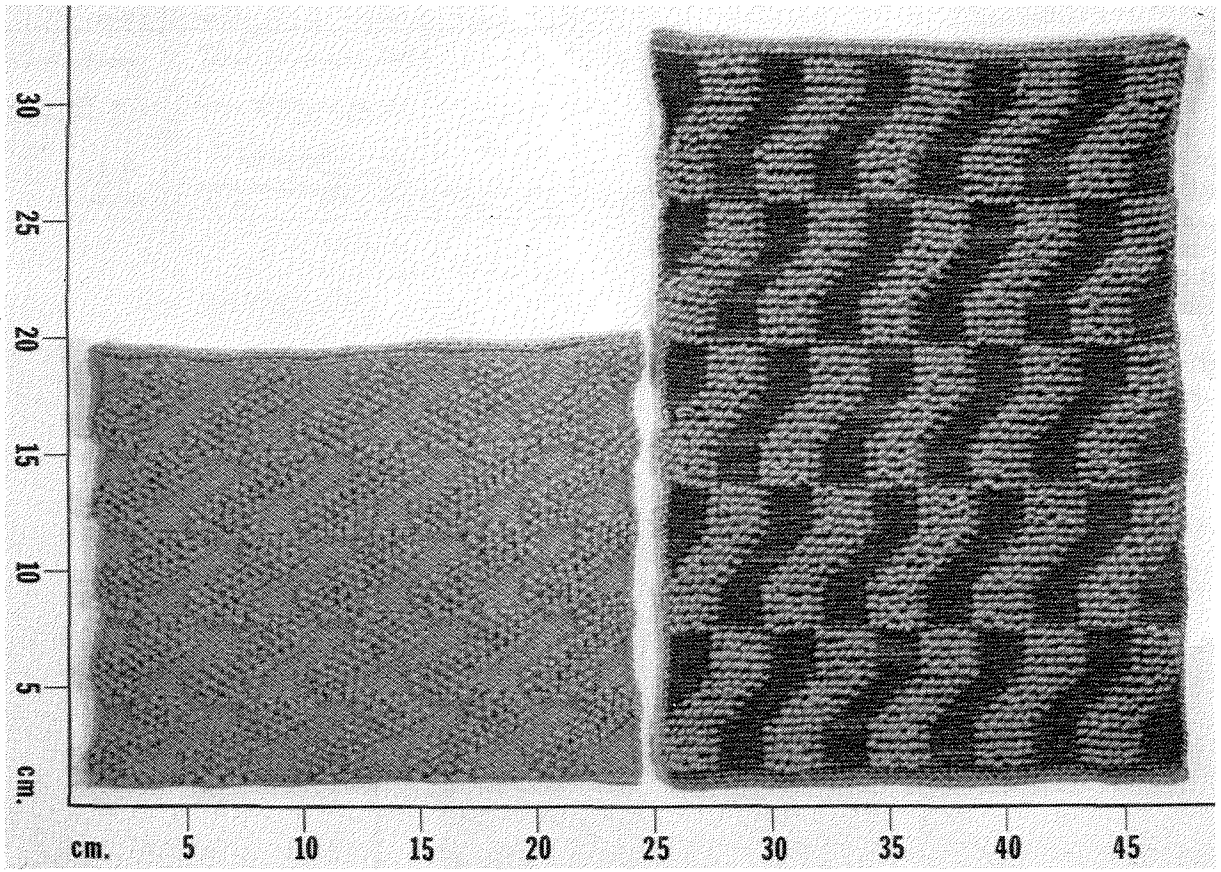


Plated plain pile made on Superba and Singer/Studio. Made with two yarns in a plating relationship on the backing.
Bottom. One row of loops knitted ER.
Top. One row of loops knitted EOR.

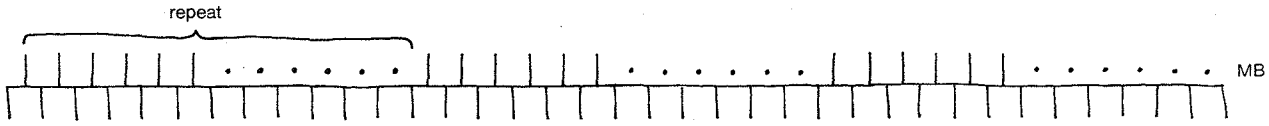
EMBOSSED PLAIN PILE

Embossed vertical stripes can be knitted in pile fabric by leaving needles out of work on the loop bed. If this technique is coupled with racking, checks and diagonals can be incorporated as well.

On Passap and Brother/Knitking, the 1x1 variation of the single-yarn method must be used rather than the basic single-yarn method, since adjacent needles cannot tuck in the areas of the backing where there are no loops on the opposite bed. On Superba and Singer/Studio, with the two-yarn method, using a plating yarn in a second color can heighten the effect of the embossed loops.



Left. Embossed racked pattern made by the 1x1 variation of the single yarn method for plain pile. Right. The same pattern made by the two-yarn plating method for plain pile.

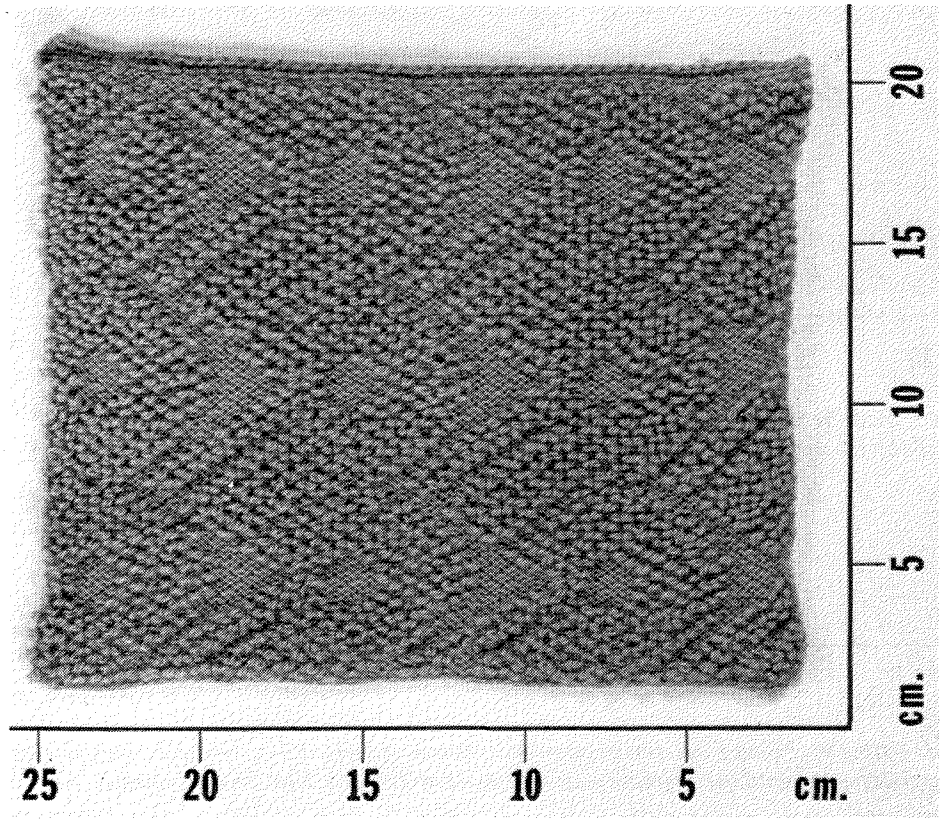


*Rack 3 needles L or R of center before setting up. *Knit 5 one-row or two-row sequences of loops. Rack one needle, knit another sequence, and continue racking between sequences until the alternate position is reached (6 racks). Knit 5 more sequences. Rack 6 needles back to starting position.**

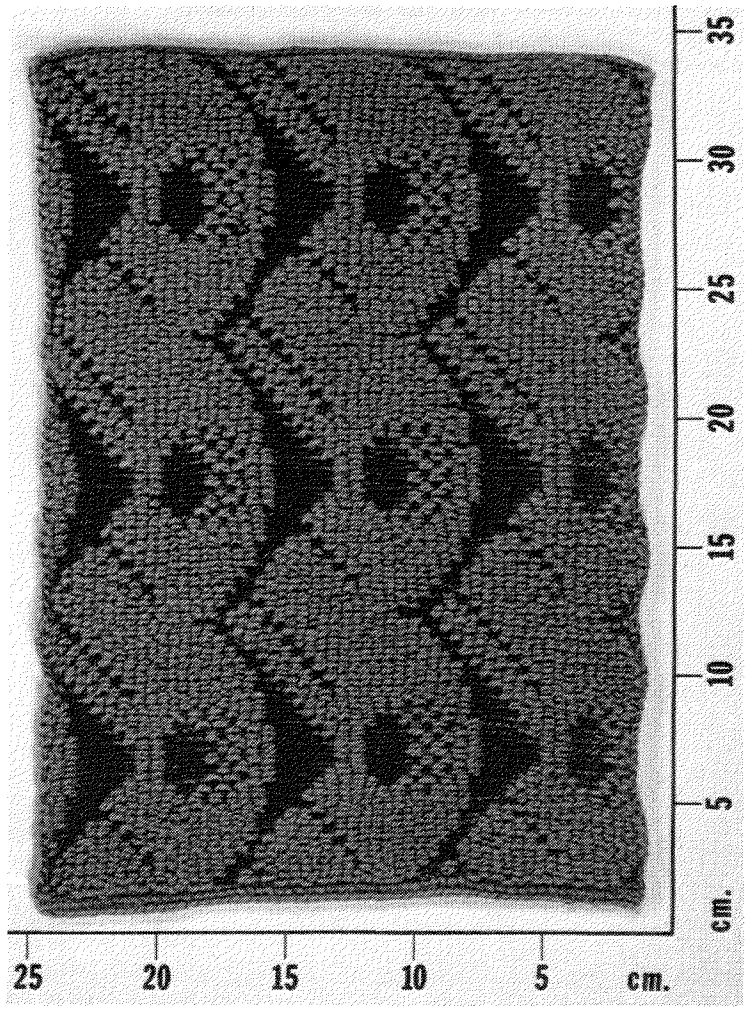
PUNCH PILE

With a punchcard, you can knit a one-color embossed pattern, the same kind of fabric made by the embossed plain pile method described above. A complex design can be knitted by using a Type A punchcard to select needles for the looped pattern. All needles on both beds are put into working position; the card will then select only the ones needed for the pattern in each row. Passap and Brother/Knitking patterns tend to condense vertically, with one row of loops per pattern row. On Superba and Singer/Studio either one or two rows of loops can be knitted per pattern row, either every row or every other row.

	Passap carr R	**Superba** carr R	**Brother/Knitking** carr L	**Singer/Studio** carr L
Punch Pile Embossed 1 color	Type A Method Plain Pile—1x1 backing FX ← push 1x1 WP/RP HXo or ← Deco 4 with ←, set front carr to N to release loops RC2 both carr; RC2 front carr to release loops.	Type A - EOR Method Plain Pile—plated backing, ER o RC2 same selection Λ neg or pos rev. pile attachment	Type A - EOR Method Plain Pile—1x1 backing part ↔ CO ribber: use pattern ruler to release loops MB N tuck → Ribber: select odd ndls, then even ndls, EOR. RC2, release loops.	Type A - EOR Method Plain Pile—plated backing, ER △ slip △ RC1 or 2, release loops MB with P carr. 1 ⌐ 1



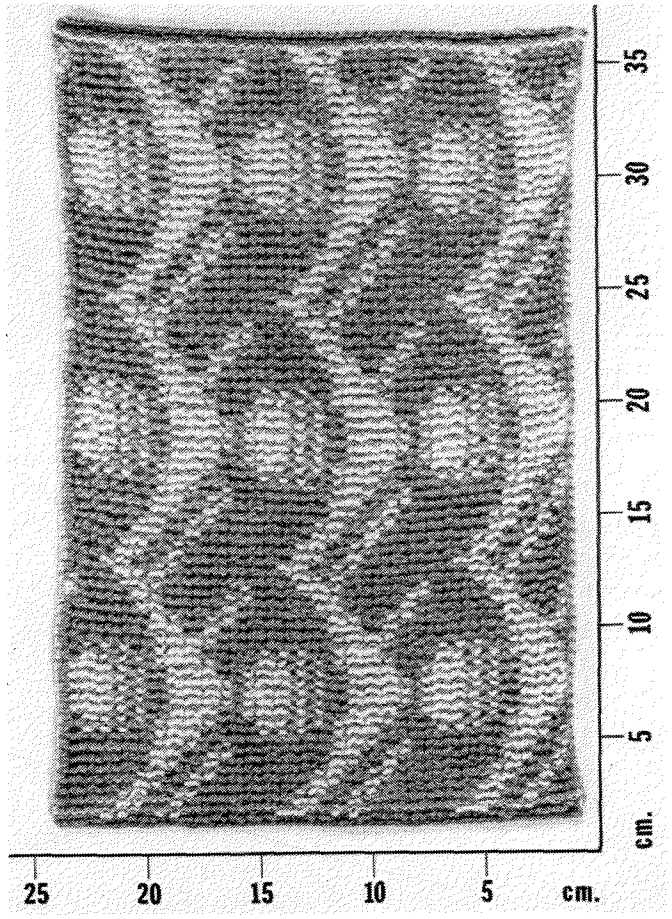
Punch pile in one color knitted by the 1x1 variation of the single-yarn method, with one row of loops per pattern row. Jacquard Pattern 4.



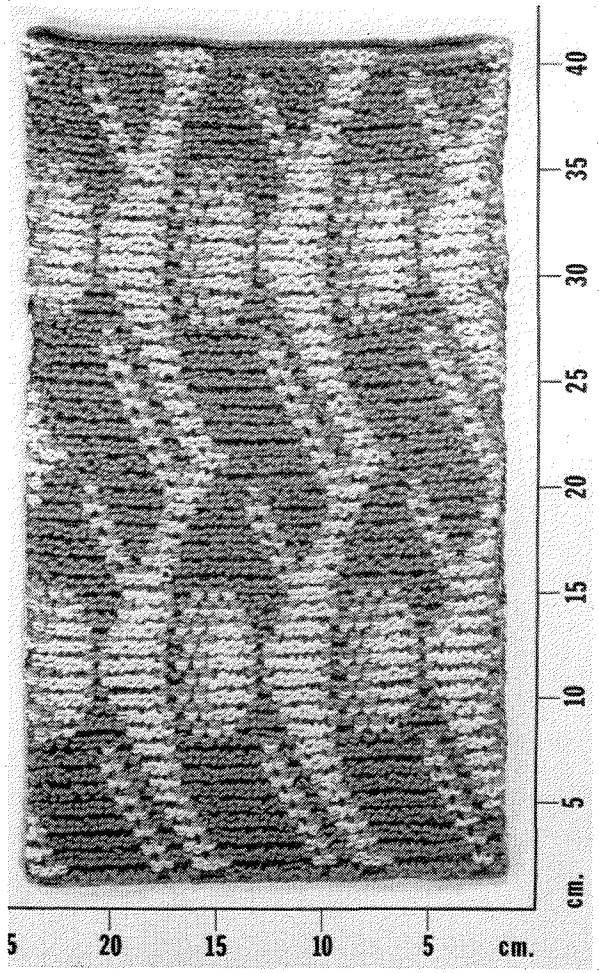
Punch pile in one color knitted by the two-yarn method, with two rows of loops per pattern row. Jacquard Pattern 4.

Pile fabric with two-color jacquard patterns can be knitted on all machines, although each achieves the effect in a different way. On both Passap and Brother/Knitking the texture of the loops created by the 1x1 selection on the backing is not quite so obvious because there is vertical spacing between the two colors. This color spacing also occurs with Singer/Studio. The photographs show how much elongation of the pattern occurs when two rows are knitted with the same selection (on Singer/Studio) versus one row (on Passap and Brother/Knitking). The Superba method is really the same technique as that for jacquard with plated backing (described in the Superba Specials section of Chapter 1), but with the main bed stitches released. A separate plating yarn is not necessary, as the two colors will plate each other, and create a dense, closely spaced pile.

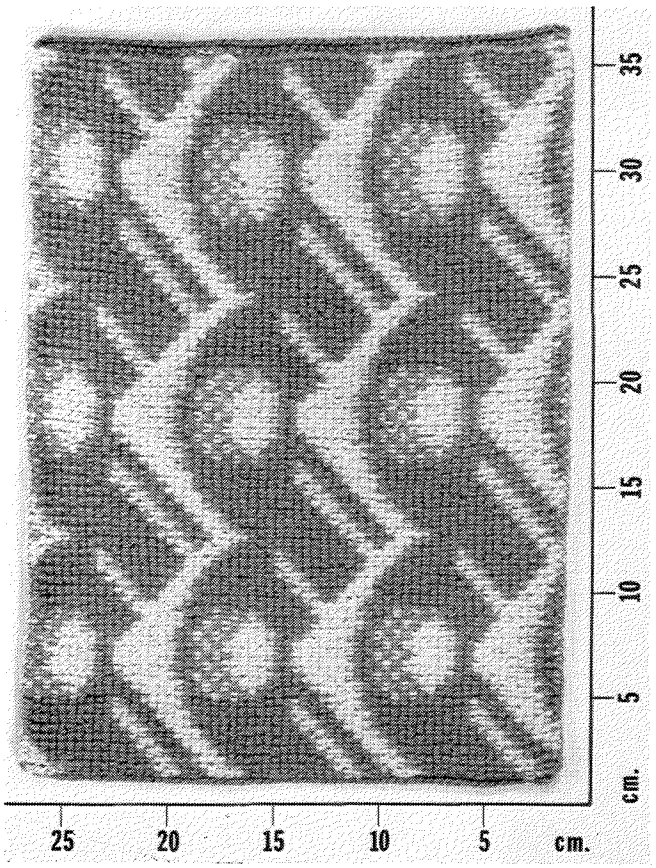
	Passap carr R	**Superba** carr R	**Brother/Knitking** carr L	**Singer/Studio** carr L
Punch Pile All-Over 2 colors	Type A Method Plain Pile - 1x1 backing FX ← push 1x1 WP/RP HX ← Deco 4 RC2 ea col, release loops with patt ruler Type C1 Deco 4 or Type C2 Deco 2 FX ← push 1x1 WP/RP HXo Col 1 - RC2 both carr; RC2 front carr to release. Repeat with col 2.	Type A - pos or neg rev ER or EOR Self-Plating Jacquard ↑ ⊓ ∧ ↑ ∧ No plating yarn. Col 1 in main feeder, col 2 in DYG. Knit 1 or 2 rows same selection DYG pile attachment	Type B - ER Type C1 - EOR Type C2 - ER Method Plain pile - 1x1 backing part ↔ N tuck → Knit as Punch Pile-Embossed, with RC2 ea col. Release loops after both colors have knit 1 patt row.	Type B - ER Type C1 - EOR Type C2 - ER Method Plain Pile - plated backing ER △ slip △ 1 ⌐ 1 plating yarn - P feeder 2 *pile colors - color changer* Hold plating yarn forward when changing colors. Knit as Punch Pile-Embossed, with RC2 ea col. Release loops after both col have knit 1 patt row.



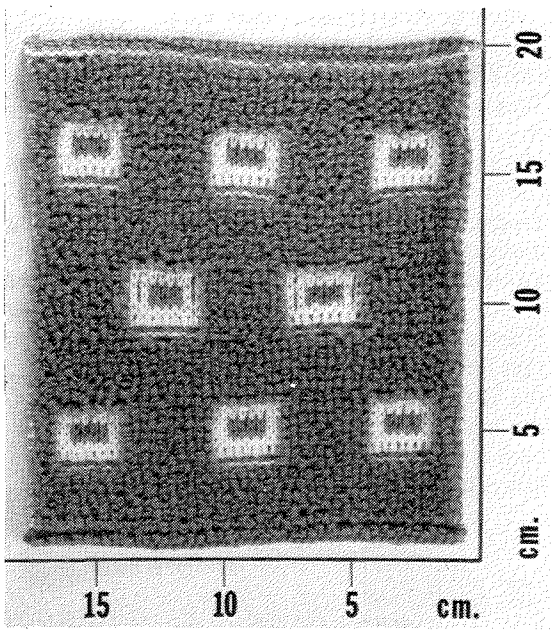
Two-color punch pile made with the 1x1 variation of the single-yarn method, with one row of loops of each color per pattern row. Jacquard Pattern 4.



Two-color punch pile made with the two-yarn method, with two rows of loops of each color per pattern row. Jacquard Pattern 4.



For Superba only. The technique is that for plated backing (described in Superba Specials in Chapter 1), with the two yarns plating each other. Knitted with two rows of loops per pattern row. Loops were unravelled after knitting. Jacquard Pattern 4.



*Two-color pile with most loops unravelled after knitting. The square pattern is manually selected with a pattern ruler for 8 pattern rows., Knitting sequence: *1.Knit 6 pattern rows with col 1 (dark) selected and col 2 (lt) not selected. 2. At start of check, drop all the loop sts. 3. Knit 8 pattern rows in check, with 8 sts per check. 4. Transfer check sts to backing. Remaining loop sts can be dropped now, or after the next step 1 is completed.* Drop all the remaining loop sts before binding off.*

A SELECTION OF OTHER LOOP TECHNIQUES

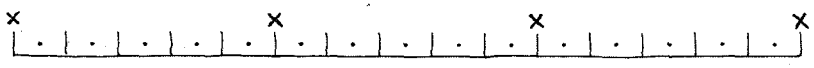
The following techniques can be done on all four machines. They can easily be adapted for other kinds of machines as well.

Shag. A single bed slip stitch fabric is knitted with long floats. After knitting is complete, the floats are cut at their centers and brushed up to produce a shag effect. For the swatch illustrated, four strands of fine yarn were knitted together and were brushed into a full, fluffy shag.

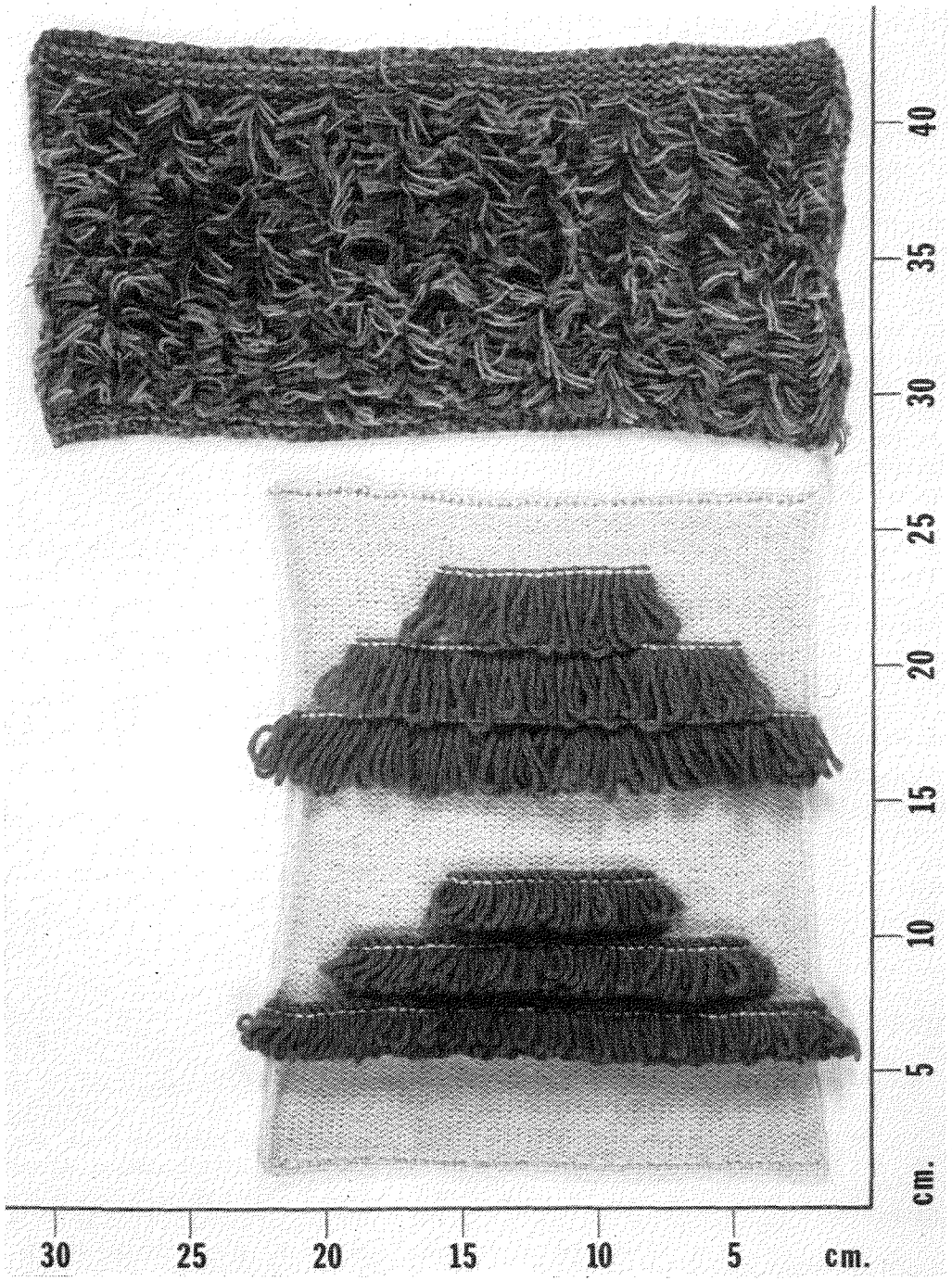
On the MB, use EON set-up with a tight SS to help increase the length of the floats after knitting. Set cam for slip. Repeat is 2 rows. Row 1: all needles knit. Row 2: every fifth needle knits while the rest slip (X needle in diagram). In the illustrated swatch, the same needles were set to knit/slip throughout, but a diagonal pattern works well, too.

Finger looping. This manual technique is done on the back bed only. The loop yarn is wrapped around both finger and needle, then the loops are knitted manually with the main color. This kind of looping is effective for trims, a row here and there in other knitting, or for several rows as additional pattern decoration. The loops can also be cut to make fringe.

Drop the front bed out of the way. Thread the MC yarn through the tension arm but not through the carriage. Place the ball of looping yarn at your feet. The loops can be from either direction, though in the illustrated swatch the direction was R to L: carriage at R. Beginning at R, take the yarn from the looping ball and knit the first stitch manually to anchor the yarn. *Push the next needle out to hold, put the first finger of your left hand under the needle and wrap the looping yarn counterclockwise several times around both needle and finger, ending with the yarn across the top of the needle stem. (In the illustrated swatch, it was wound three times.) Then lay the MC yarn across the hook of the needle and pull the needle back, thus manually knitting the stitch and enclosing the loops.*



Set-up for shag.



Top. Shag. Center. Finger looping. Bottom. Dropped bed looping.

Repeat. Knit the last needle plain, like the first. Put the carriage into free move to go across and retrieve the MC yarn, and knit several rows before beginning the next row of loops. When making loops L to R, reverse the winding direction.

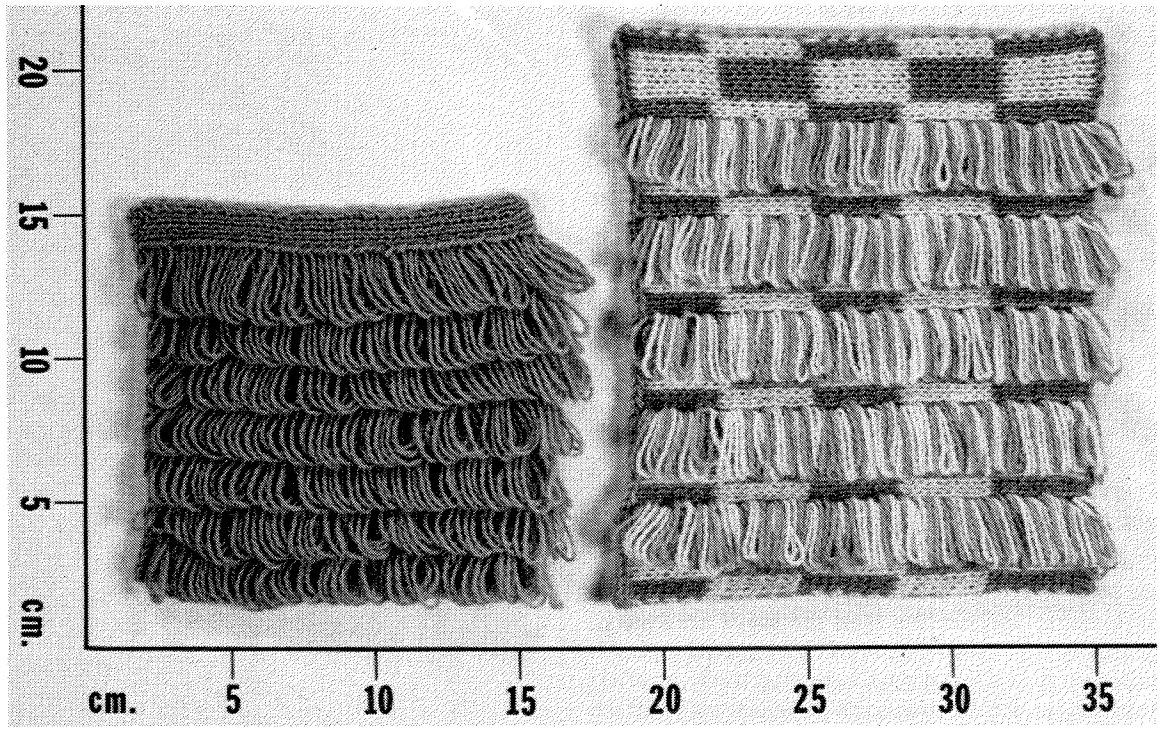
Dropped bed looping. Loops are made on the back bed with the help of the front bed, which is in a dropped position. This technique is basically the same as the single-yarn method of knitting plain pile, but here it is done manually and on a larger scale. The loop yarn is zigzagged manually between the beds, then knitted in place on the backing bed with the carriage, threaded with the main color.

Put the ball of looping yarn at your feet. It will zigzag between the back bed and front bed needles, and the position of the front bed and its needles will determine the length of the loops. The front bed has one needle less at each end in WP than the back bed.

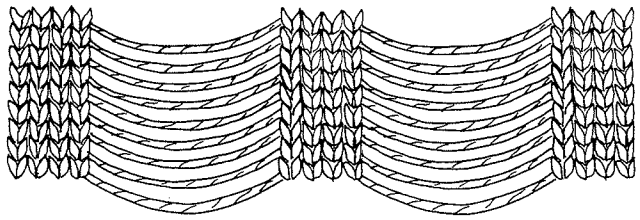
Beginning at either end of the bed, knit the first stitch on the back bed manually with the looping yarn. *Put the yarn around the next needle hook on the back bed, but don't knit it, then around the opposite needle hook on the front bed.* Continue zigzagging in this manner across the row. Move the back bed carriage with the MC across slowly, holding the loops down with one hand, if necessary. Release the loops from the needles on the front bed.

Folded fringe. Use a standard method for knitting fringe, following the instructions given in most pattern books. Sew the edges of the knitted panels together so they form a backing fabric, with the loops folded in half between the panels. If you want the knitted panels to show on the front, knit wide bands with shorter floats. You can make fancy tucks and racked patterns in the bands, or make jacquard patterned bands, which will have full, two-colored loops. This technique works well for small rugs or pillow tops. Or you might knit narrow panels with long floats which will hide the backing when folded.

Put in WP only those needles on one or both beds which knit the panels; ndls in NWP between panels will form floats for the fringe. After knitting, sew the panels together; the loops will fold in half to make the fringe.



Left. One-color fringe with narrow knit bands.
Right. Two-color fringe with wide knit bands.



Knitted panels for folded fringe after removal from the machine, before folding and sewing.

CHAPTER 9
Intarsia

Intarsia is a technique for color patterning. It can be a delight for the knitter who loves splashing with color and playing with shapes, or has a fondness for pictorial themes. A flat fabric, usually in stockinette, it is one of the most "painterly" forms of knitting.

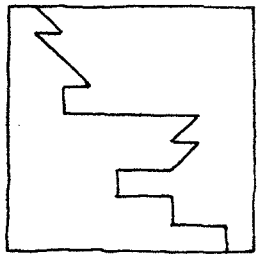
Intarsia borrows its name from the Italian word for wood inlay or marquetry that was popular during the 15th century. It is a way of laying colored shapes into a background. It differs from other kinds of color patterning in that each different color of yarn knits back and forth across the bed only within its own shape, without traveling behind or through any of the other shapes of the design, whether knitted in the same or a different color. Therefore in jersey, or single bed fabrics, there are no floats on the reverse side. There are several different techniques that can be categorized as intarsia, ranging from almost automatic to manual. Intarsia is generally made single bed in stockinette or in a textured slip or tuck stitch; yet in some instances it can be knitted double bed, emerging as a reversible fabric in plain or patterned rib.

Intarsia designs are usually composed of very simple geometric shapes. Because needles in large scale designs—wider than a punchcard—must be manually selected, the designs are charted on graph paper, or can be drawn on a garment pattern and run through the charting attachment. Small scale designs can be punched on a card and knitted more or less automatically.

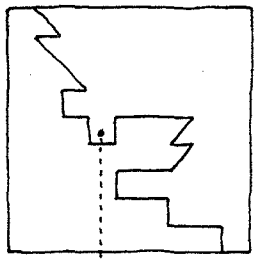
The three general methods of knitting intarsia are described below. Each has qualities which make it suitable for particular kinds of designs. You can either choose a technique which best suits your machine and design patterns around the technique, or you can make the design first, then choose the technique by which it can be knitted most efficiently.

KNITTING TWO SHAPES ACROSS THE FABRIC WIDTH SIMULTANEOUSLY

The simplest form of intarsia, and the quickest to knit, involves a pattern with only two shapes knitted across the width of the fabric. The colors for the two shapes are either knitted together, using the double yarn feeders, or are knitted alternately (RC2 each color), using the color changer. The fabric will be divided into the two shapes more or less vertically. The left selvedge must be in one color, the right in the other color. The area between can be divided into two parts consisting of diagonal, vertical and horizontal divisions as long as one color does not create a negative space within the other, as indicated in the sketch.



Right: two shapes across width.



Wrong: more than two shapes across width.

This method is especially suitable for knitting a large scale pattern with a wide color division, by using manual needle selection. For designs with a narrower color division, a punchcard may be used to speed the needle selection.

Two shapes with vertical and diagonal patterning, using the double yarn feeders.

Two shapes, with vertical and diagonal patterning but no horizontal patterning, can be knitted on Superba, Brother/Knitking and Singer/ Studio by using double yarn feeders. The most effective designs made by this technique are shapes with vertical divisions, or diagonal divisions which step by one needle on successive pattern rows, either every row or every other row. (Every other row is easiest for wrapping needles at the point where the two shapes join.) Horizontal divisions, which are made by more than one needle changing color at once, will cause floats and are not suitable for this technique.

To knit this fabric with manual needle selection, start with the carriage at left. Thread color 1 (for the left side) in the main feeder and color 2 (for the right side) in the second feeder.

Set cams for jersey jacquard. *Carriage L: push needles at R side for col 2 out to patt pos or HP (with holding cams set to move needles back to WP). At L, needles for col 1 remain in WP. Knit across. Carriage at R: Push needles at R out again, lift col 1 yarn up and lay across the tops of these needles. If you want wrapping, leave the yarn *under* the first needle, which will automatically wrap it when the next row is knitted. Knit across.* Repeat.

Additional patterning can be created by cutting both yarns and switching feeders. Stripes can be knitted in the color 2 section by changing the yarn in the second feeder where desired. And, an occasional horizontal division can be incorporated as long as it is not more than about ten needles wide. After the row has been knitted, hang the resulting float on a central needle or two, and continue knitting.

Note that wrapping occurs only once every two rows, to produce a solid join between the colors. If you prefer eyelets on the diagonals, leave the needles unwrapped. On verticals, however, an open slit will result unless wrapping occurs once every 4 rows to make eyelets, or every 2 rows with both colors, for a solid join.

Punchcard selection of needles can speed the needle selection if the patterning between the two colored sections does not exceed the width of a punchcard. Use a Type A punchcard; punch holes for color 2 on the right side of the card and leave unpunched spaces for color 1 on the left side of the card. On the needle bed, use isolation cams to isolate the area where the punchcard needle selection is to occur, as is done for isolating a motif in jersey jacquard. Before each row is knitted, the extra needles beyond the isolation cam area to the right must be brought out to patterning position or holding position, as for manual patterning. Threading the carriage, the cam setting, and other procedures are also the same as for knitting manually.

Two shapes with vertical and diagonal patterning, for Passap.

Following is the technique used on Passap to knit two shapes with vertical and diagonal patterning (but not horizontals), using the single yarn feed method. Two rows will be knitted in each color with a change in pattern rows every RC4. Two completely knitted rows equal one pattern row, as in jacquard. In all intarsia work, use of modified blades for the black strippers is recommended. These are described in Reference Chapter 5.

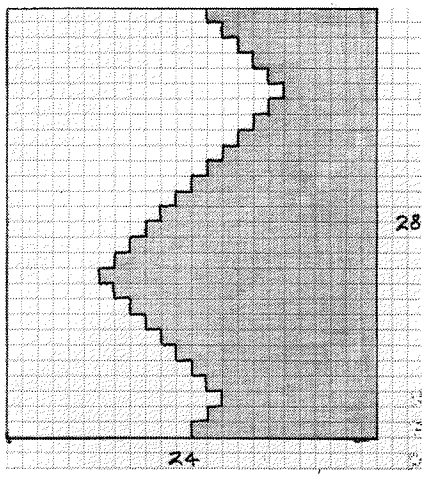
On the front bed place a pusher under every working needle. Set cam to BX with left arrow key. Thread color 2 (which will knit the right side of the fabric) into the feeder at the left side of the color changer. Color 1, which will knit the left side of the fabric, goes into the feeder to the right of color 2. This arrangement prevents tangling of the yarns at the selvedge. Place pushers for the first pattern row in RP on left for color 1 and in WP on the right for color 2. The left side always knits first. Keep in mind that the left arrow key will switch the pusher positions for you.

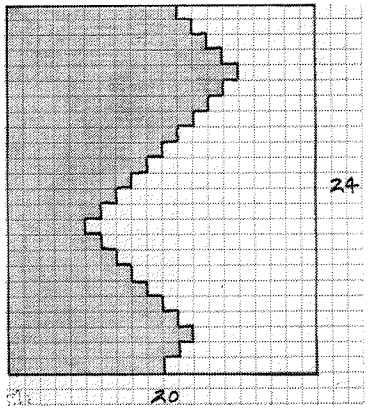
Cast on in color 2. *Knit RC2 with color 1, then RC2 with color 2. Arrange pushers for the next pattern row* and repeat.

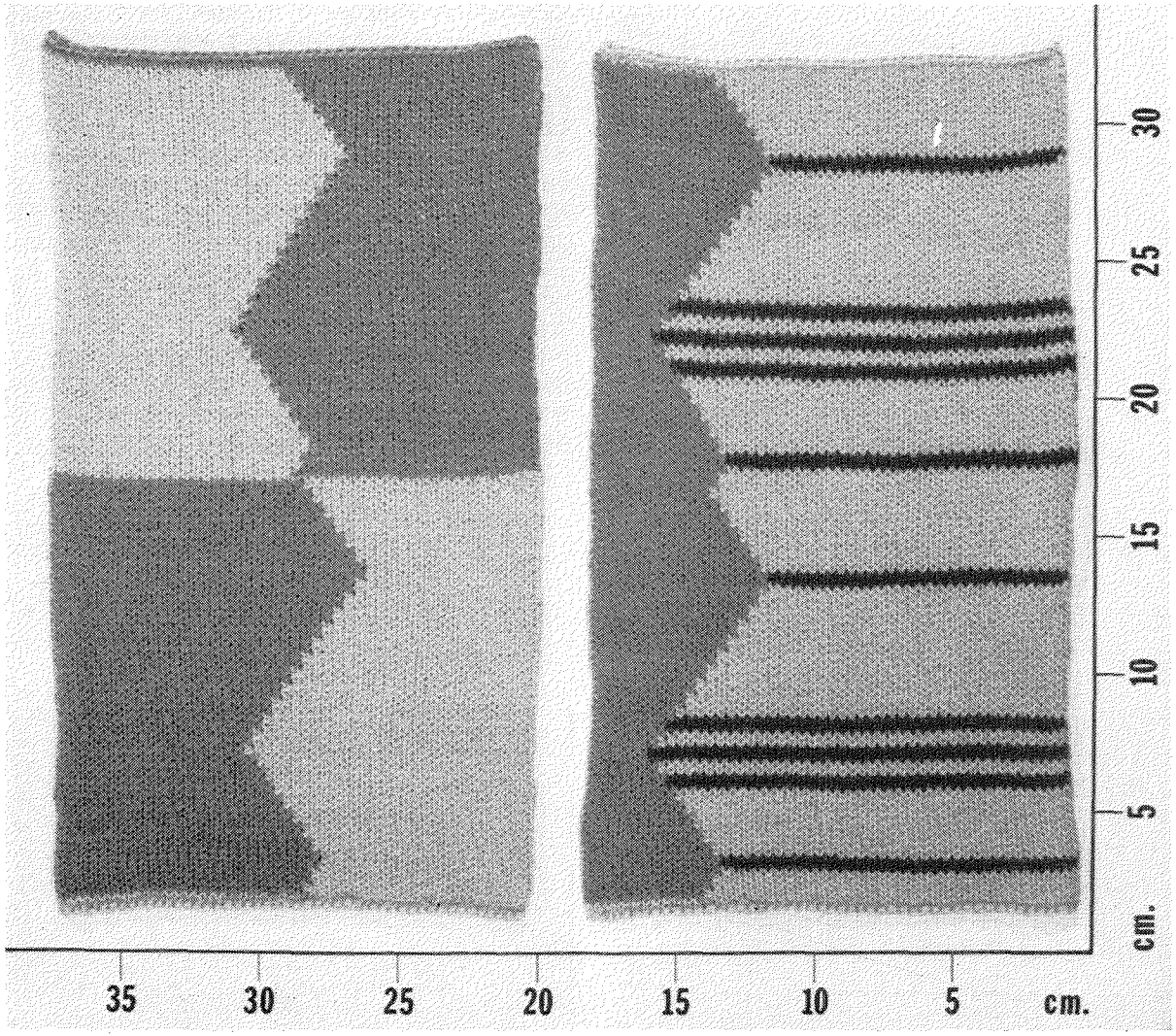
As on the three other machines, this method works best with diagonal patterns that step by one needle each RC4, and for verticals. Changing more than one pusher at a time will create a horizontal and cause a float with color 2. An occasional horizontal won't hurt; simply hang the float over a central needle and continue knitting. For wrapping, place color 1 yarn in the hook of the adjacent needle at right after knitting RC2, otherwise there will be eyelets between diagonals and slits between verticals. If you want vertical eyelets, wrap with color 1 every other pattern row. On long verticals, manual wrap can be eliminated by placing one needle on the opposite bed in WP at the point of the color change, set the carriage to N or CX. Make sure the beds are at half pitch, and use a small stitch size. This single needle will knit both colors and make an automatic join. For additional patterning, yarns can be cut and switched in the feeders or stripes can be knitted on the section nearest the color changer. Thread the stripe color between colors 1 and 2.

A punchcard can be used to select pushers for patterning, if the patterning between the colors doesn't exceed 40 stitches in width. All the spaces for color 2 on the right side of the card are punched out. (They will be on the left side during punching, on the right side as seen in the card reader.) Spaces for color 1 on the left side of the knitting are left unpunched. Cams are set at BX with left arrow key. For fabrics wider than 40 stitches, isolation pins must be used. If you want to use the Deco coupled to the carriage (set at 4), the card reader must be placed at the right selvedge, as the isolation pins cannot be used on the right side of the card reader in intarsia knitting. This is because extra pushers beyond the card at right will automatically knit color 1 instead of color 2. If you *must* have extra stitches at the right, isolate the reader on both sides, set the Deco at 2, uncouple it from the carriage and move it L-R-L by itself each pattern row. The isolated pushers at right can then be moved manually to WP, so when the four rows are knitted, these stitches will be in the proper color.

Intarsia Pattern 1. For manual or punchcard patterning. Punch as Jacquard card Type A-1. For Passap, punch left half; for other machines, punch right half.







Two shapes with diagonal and/or vertical patterning; intarsia Pattern 1.
Left. Colors in yarn feeders cut and switched for second repeat.
Right. Color 2 yarn changed with a third color for striping.

Two shapes with vertical, diagonal, and horizontal patterning, for all machines

To knit two shapes with vertical, diagonal, and horizontal patterning, only the single yarn feed method can be used; the colors are changed every 2 rows. Here, manual needle selection allows a little more freedom in designing in that horizontals can be incorporated without floats, together with verticals and diagonals. The double feeder cannot be used, and two knitted rows per pattern row must be made (EOR). The method is the same on all machines.

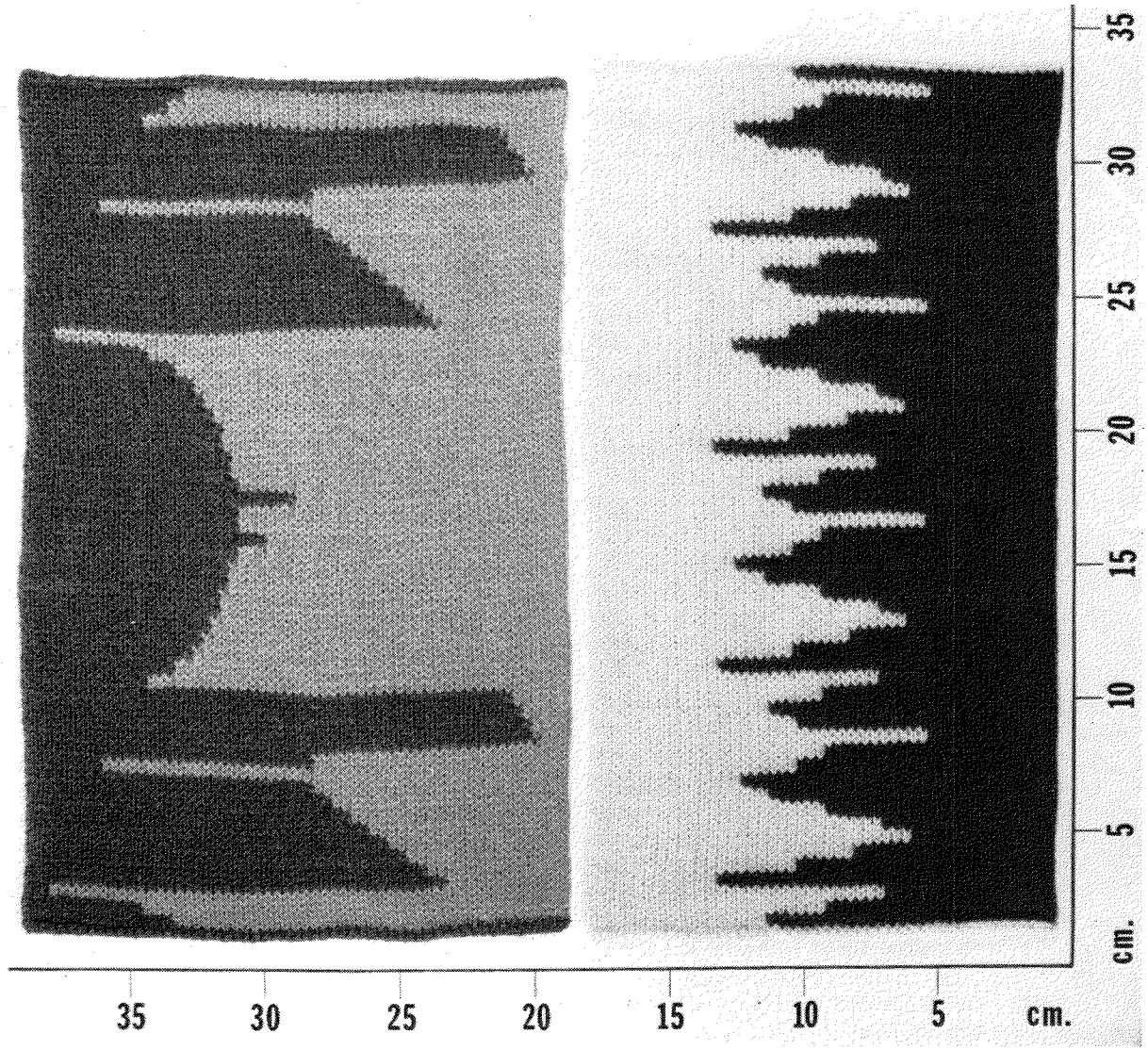
The sequence begins when the carriage, holding color 1, is at the side opposite the color changer. Knit one plain row at the start to bring the carriage to this side. With the needle selection for the first pattern row, color 1 knits one row, color 2 knits its two rows, then color 1 finishes its second row. The carriage will again be at the side opposite the color changer. Needle selection is changed for the next pattern row, and color 1 begins its first row again.

The setting up and starting sequence would be as follows: On Passap, arrange colors in feeders and pushers on the front bed the same as in the method for knitting vertical and diagonal patterning. Cast on in color 1, ending with the carriage at right. Knit RC1, col 1, lock set to N with left arrow key. Then with the carriage at left, switch to BX with the left arrow key for the rest of the knitting. *Knit RC1, col 1; RC2, col 2; RC1, col 1; change pushers* (carriage at L). Repeat. For wrapping, hook col 1 into the adjacent needle at right after the first RC1.

For Superba, Singer/Studio, Brother/Knitking; set cams for slip in both directions. Col 1 at R side of changer knits R side; col 2 at L side of changer knits L side.

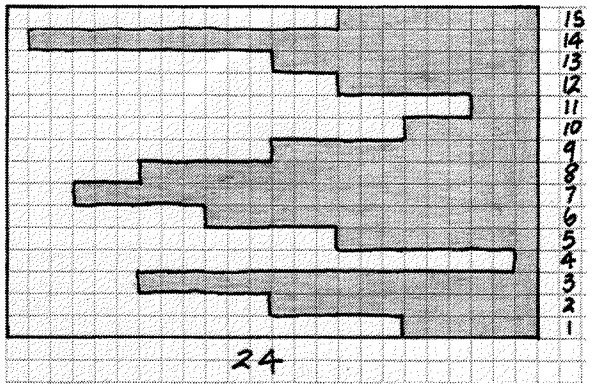
Cast on col 1, ending with carriage R. *Select needles at R to patt pos or HP. RC1, col 1; change colors. Select needles at L side of knitting. Put color 1 yarn over first adjacent needle at L and under the rest, for wrap. Knit RC1, col 2; select same needles again; RC1, col 2. Change color. At R, select same col 1 needles again, RC1*. Repeat for each pattern row.

Needle selection with a punchcard can be made on Superba, Brother/Knitking and Singer/Studio, since their punchcards can rotate every row. This kind of pattern can be knitted on Passap, with a punchcard, by following the technique for knitting vertical and

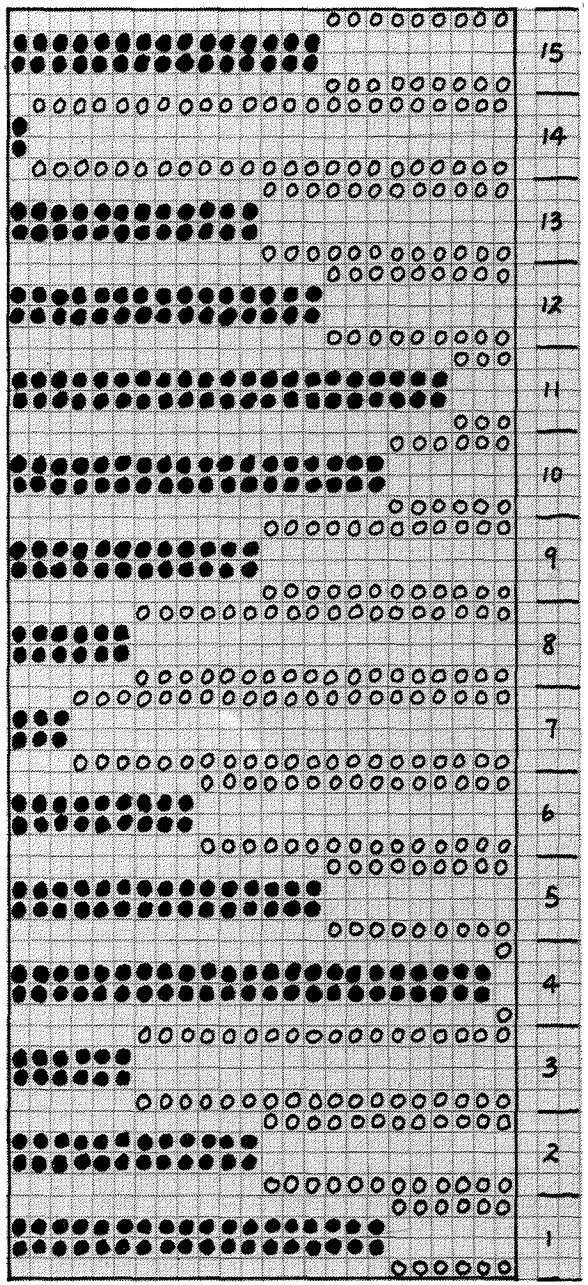


Two shapes with diagonal, vertical and horizontal patterning.
Left. Knitted manually; intarsia Pattern 2.
Right. Knitted with punchcard; intarsia Pattern 3.

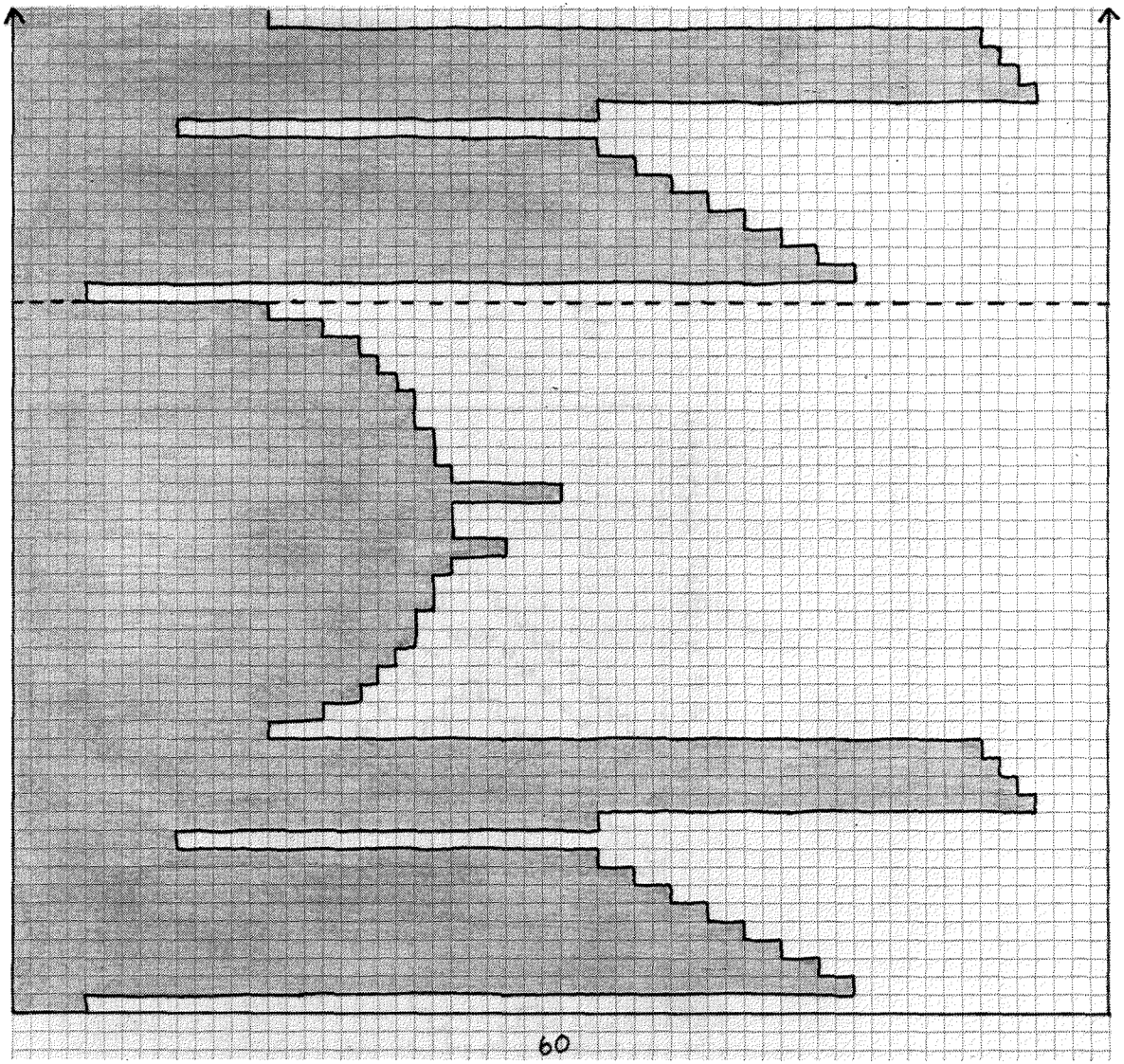
diagonal patterning above, but there will be floats on all the horizontals. For Brother/Knitking and Singer/Studio, the card is punched like a Type B card, with slight modification. For Superba, make a geometric card such as intarsia Pattern 3 (a Type A card), but with each pattern row two rows tall. The design can be up to 56 stitches wide. Knit the pattern in the Norwegian jacquard technique, with the jac claw, using the Norwegian jacquard setting on the box with the positive reverser. (More specific directions are found in the instruction manual.) For all machines, isolating the pattern and knitting the extra needles beyond the isolation cams is done the same way as in the method for knitting vertical and diagonal patterns above. The cam setting and color change sequence is the same as with manual selection.



Intarsia Pattern 3.



Punchcard for intarsia Pattern 3, a Type B card modified. Preparation row is left to right. Start card with carriage right; ER rotation.



Intarsia Pattern 2. For manual patterning. One repeat = 39 pattern rows.

KNITTING AN ISOLATED MOTIF OF THREE OR FOUR SHAPES WITH A PUNCHCARD

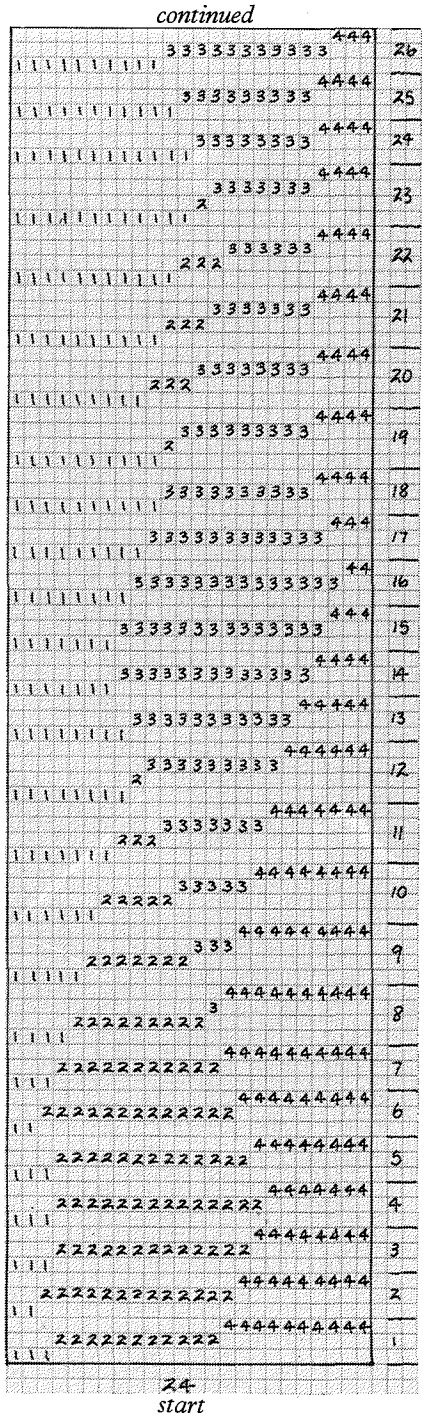
In this intarsia method, an isolated motif consisting of one or two shapes can be laid into a background consisting of two more shapes, with one portion of background on each side of the motif, for a total of up to four shapes across the fabric width. All the shapes are knitted simultaneously, as in the two shapes method just described, with two rows of each color in turn. The motif is limited to the width of the punchcard, and the number of shapes is limited to the number of yarn holders in the color changer—four. Of course, this kind of knitting can be done manually too, with more and larger shapes up to the full width of the fabric. If you want to try it, use the techniques for tapestry knitting, described later in this chapter.

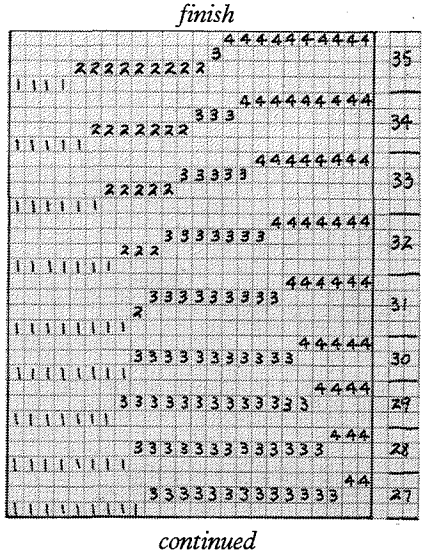
The principle of punching the card and knitting the motif is very similar to that for three- or four-color jacquard. A Type D card is used, each color knits in turn, the machine is set to rotate the card EOR (2 knitted rows for each pattern row), and cams are set to slip in both directions.

Referring to the intarsia Patterns 4 and 5, first chart the design on graph paper. Make sure there are no more than four shapes across the width for each pattern row. It's a good idea to number the shapes on each row from left to right to avoid confusion when marking the card. *The order of the colored shapes must remain the same each pattern row throughout the design,* though one or more of them can be skipped.

Now mark and punch the card according to the directions for Type D card in Reference Chapter 4. Large sections of pattern rows may not use all four colors, as in Pattern 5, but do not leave blank rows for missing colors as you would in jacquard. Instead, punch only the colors needed and mark the edge of the card with the color for each row. Always punch the lower color number in each pattern row *before* the higher color number. Work from left to right, as shown in Pattern 5. Pattern 4 is punched the same way. Note the vertical join in Pattern 4. The card is punched so this needle knits *both* colors, which automatically joins the two shapes.

On all machines, thread the color changer so color 1 is at the extreme left and color 4 at the extreme right,



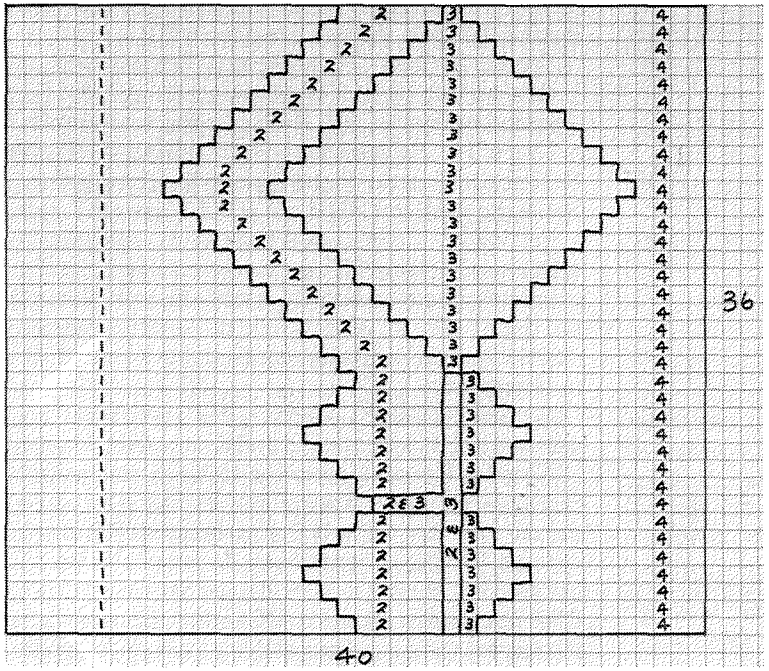


Punchcard for Pattern 5, a Type D card.

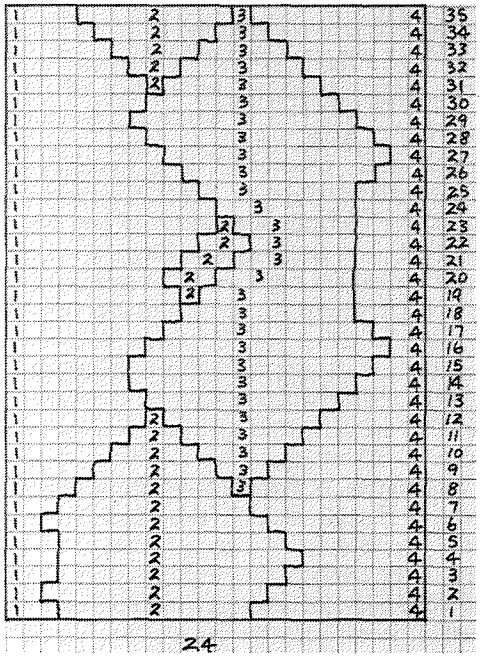
and knit each shape in turn. You will be working from left to right across the row on Japanese machines, and right to left on Passap. To wrap, hook each yarn in the adjacent needle after it has knitted the first of its two rows.

Since the pattern is to be a motif within a larger fabric, the card must, on all machines, be isolated within isolation cams. Needles beyond the isolation cams on either side must be brought to pattern position only on the rows which each selvedge knits, as in the Two Shapes method described in the previous text section. On Passap, the Deco (at 2) must be moved manually, as described before, with extra pushers at each side brought manually to WP on the appropriate rows.

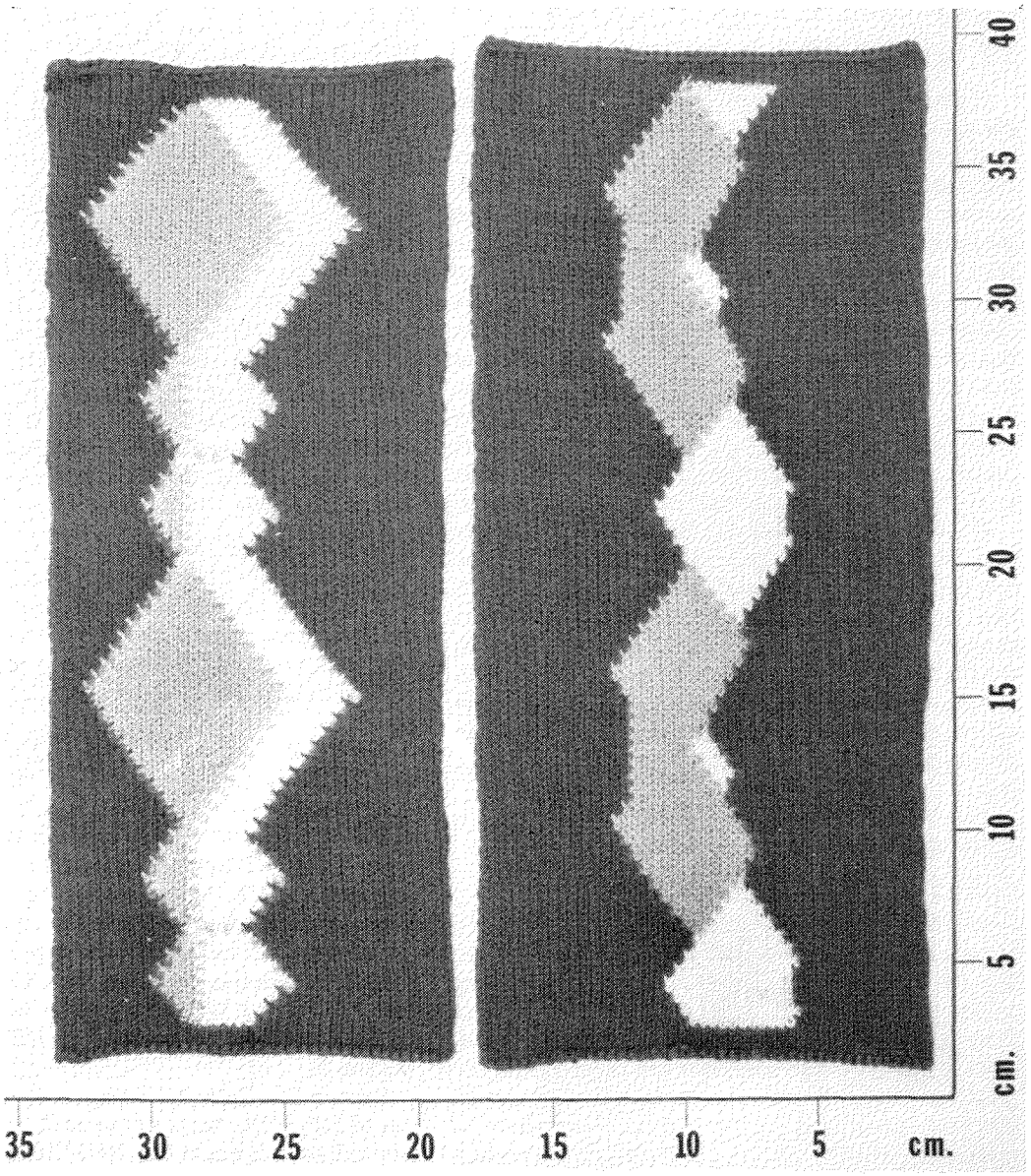
In all punchcard knitting the design can be reversed (to knit the two halves of a cardigan front, for example) by turning the card backward and reversing the order of colors in the changer.



Intarsia Pattern 4, an isolated motif.



Intarsia Pattern 5, an isolated motif.



Isolated motif knitted with punchcard.
Left. Knitted on Passap; intarsia Pattern 4. Knit with eyelet join to avoid manual wrap. Vertical join between 2 and 3 accomplished by knitting the joining stitch twice each pattern row, once in each color. Right. Knitted on a Japanese machine, using intarsia Pattern 5 with wrap. Not all shapes are represented every row in this pattern.

KNITTING INTARSIA SHAPES BY SHORT ROW SHAPING

If you are not already familiar with this concept, also known as *graduations* or *partial knitting,* get out your instruction book and make a few darts before you try knitting intarsia this way. You'll have fun! While this method is still restricted to geometric shapes built on diagonals, verticals and horizontals, it offers a much wider scope for patterning than does the method described in the previous section. In short row intarsia, shapes can be isolated as motifs or can be knitted across the fabric in an all-over pattern, with as many shapes as desired across the width. Furthermore, short row intarsia can be knitted single or double bed, and can incorporate punchcard tuck and slip stitch texture patterns, or two-color jacquard patterns. It is usually knitted manually, but can be knitted with a punchcard.

It's a good idea to first knit a design manually, rather than with a punchcard, to learn the principle of short row intarsia. With large and complex patterns which may involve shapes of different sizes, the pattern should first be drawn on a graph. Color the shapes in the shades to be used, and indicate the order in which the shapes or portions of shapes are to be knitted. It is easiest, for wrapping or for a neat row of eyelets, if the diagonals in the design step by one needle each pattern row.

The isolated diamond motif on the adjacent graph is a very simple example of the technique.

SHAPES WITH DIAGONALS

Where more than one shape occurs within a group of pattern rows (pattern rows 6 to 15 and 16 to 24 on the graph below), the shapes which have *decreasing* angles, such as B and C on the graph, must be knitted first, one at a time, while all the other stitches are held. Then the shapes with *increasing* angles, as D1 on the graph, are knitted, while the stitches already knitted are held. After pattern row 15, the procedure is reversed: D2 is knitted first, as it has the decreasing angles, while E and F are held.

When automatic wrap is used, wrapping occurs with the yarn knitting the *decreasing* angle only. The increasing angle which fills in against the wrapped decreased angle does not need to be wrapped, though with manual wrapping the join between the two shapes looks better if the wrap is on both angles.

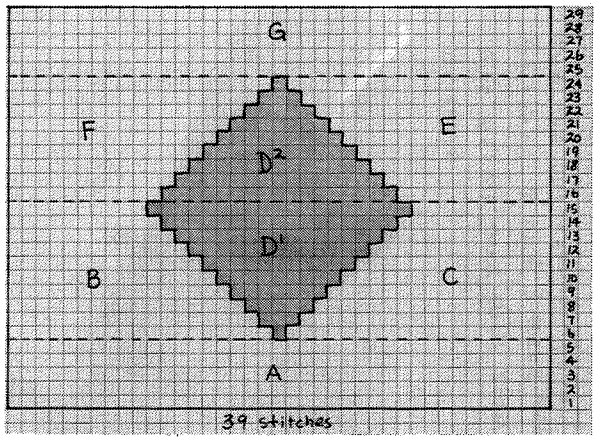


Diagram of intarsia Pattern 6, showing order in which parts are knitted. Each pattern row consists of two rows knitted identically.

How to Knit the Diamond

The directions below are for a swatch knitted single bed, with the carriage set for stockinette and holding position. Each pattern row is two knitted rows, with automatic wrapping. You will need two balls of color 1 and one ball of color 2, all threaded through the tension mast.

Section A. Cast on 39 stitches. With col 1, knit at least 10 rows across all ndls, ending with carriage at L.

Section B. Color 1, 20 ndls at R on hold, 19 ndls at L in WP. *RC1, first WP ndl at center to HP, RC1* 10 times. (This will automatically wrap.) Put remaining ndls at L in HP. Save yarn for knitting section F, hooking it around end of bed or in color changer.

Section C. Color 1, move carriage (free pass) to R side. Attach another col 1 yarn. Take 19 ndls at R out of HP. *RC1, first WP ndl at center to HP, RC1* 10 times. Put remaining ndls at R in HP. Save yarn for Section E.

Section D1. Color 2. Carriage at R. Take center ndl out of HP, RC1, *next ndl to its R out of HP, RC1, next ndl to its L out of HP, RC1* 10 times altogether. (Ndls are always put back into HP on the side opposite the carriage.) Hint: knit the first stitch manually or lift up on the weight, as this stitch tends to fall off.

Section D2. Color 2. Carriage at R. *Put the first edge ndl at R side of diamond in HP, RC1, put the first edge ndl at L side of diamond in HP, RC1* 10 times. (This will automatically wrap.) Keep moving one ndl inward on the same side as the carriage each RC1. Break col 2 yarn. All ndls are now in HP.

Section E. Color 1. Carriage at R. Rethread with col 1 yarn waiting at R. Take R side ndls and the first diamond ndl out of HP, RC2, take the next diamond ndl out of HP, RC2; move one more ndl out of HP each RC2 until all but the center diamond ndl have knitted. Break the yarn. Put all ndls in HP, free pass to L side.

Section F. Color 1. Carriage at L, thread with waiting col 1 yarn.* Take L side ndls and the first diamond ndl out of HP, RC2; take the next diamond ndl out of HP, RC2; move one ndl inward as before until all but the center diamond ndl have knitted. Do not break yarn.

Section G. Color 1. Carriage at L; take remaining ndls out of HP, knit across all ndls for at least 10 rows.

Note for Passap: Follow the above directions with carriage set to BX (no arrow key) and a pusher out of the rail for every WP ndl. Put pushers into RP to hold sts; into WP for knitting them. As automatic wrap is not possible, the ndl to be held must have its pusher in RP *before* the row is knitted. RC1, wrap the next ndl by placing the yarn in its hook and knit back. If you prefer not to wrap and don't mind a small eyelet, put the pusher for the ndl to be held into RP *after* RC1 is knitted and do not wrap the next ndl.

SHAPES WITH VERTICALS AND HORIZONTALS

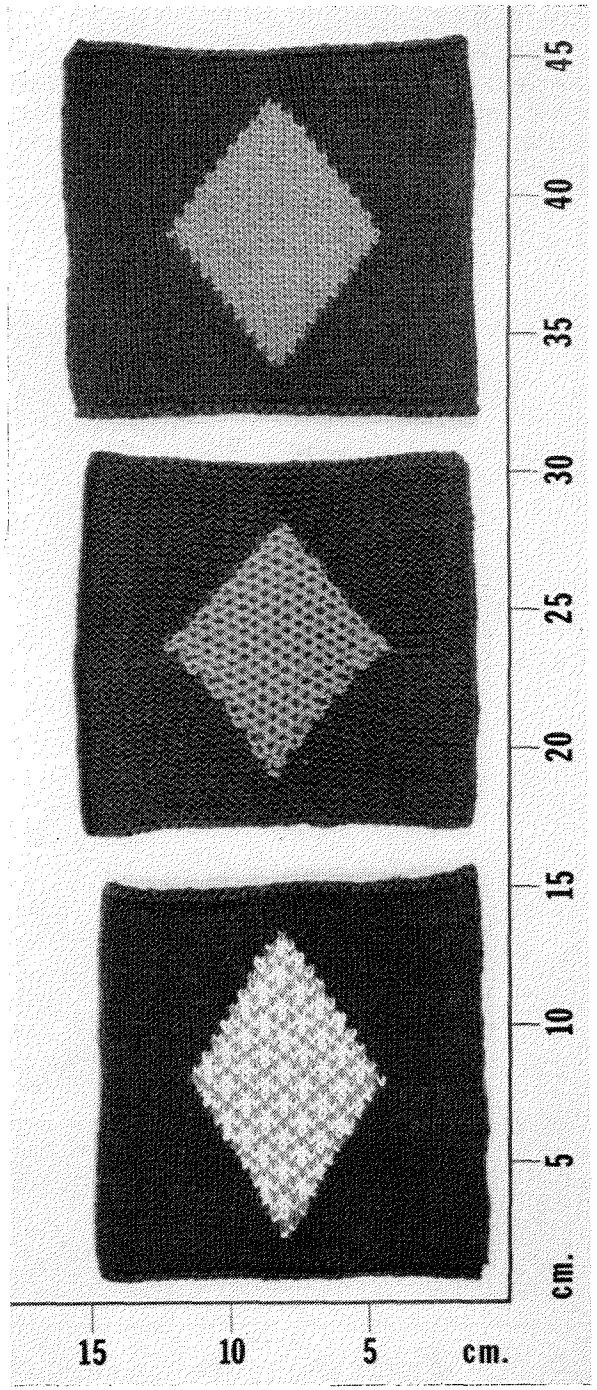
For vertical slits, proceed as you would with diagonals, but without wrapping. Knit the sections on either side of the verticals separately. If you want wrapped verticals, the two shapes on each side of the vertical must be knitted together (for example, two rows of each color, knitted in turn), and it is best to wrap both colors for a firm join. If stitches from other shapes must be kept in hold while this is being done, knit them back to NWP with a ravel cord. If it is more convenient, knit the vertical as a slit, and sew the two sides together after knitting, or use the "seam as you go" method of joining. A shape with a horizontal edge is easy—simply change color. If you are knitting a pattern with eyelet joins in the diagonals, then you may want eyelets in the horizontal as well. Transfer every other stitch to the adjacent needle, leave empty needles in WP, and proceed with the new color. Vertical eyelets can be made by knitting four rows each color between wraps, instead of two rows each color.

TIPS FOR KNITTING SHORT ROW INTARSIA

1. Shapes, or portions of shapes, with *decreasing* angles in their diagonals are knitted first; the adjacent shape with the *increasing* angle is knitted second.
2. Especially for practice, use a good strong yarn that will tolerate pulling and friction.
3. Plan to knit two pattern rows with the same needle selection so you can incorporate automatic wrapping (it is manual on Passap).
4. Be sure to set the carriage for keeping needles in HP, even on rows where no stitches are held. It is easy to forget to reset it.
5. Try to begin and end adjacent sections of the same color with the carriage at the same side so the yarn doesn't have to be cut. You can hold extra yarn from other shapes, without cutting it, by placing it in the color changer or hooked around the end of the bed. An extra tension mast clamped on the machine or its stand is helpful for holding more yarn.
6. Have a good supply of extra claw weights at hand. Short row knitting requires a great deal of adjustment to hold down the uneven rows of stitches.
7. On Japanese machines, protect held stitches from the friction of brushes by covering them with plastic wrap, foil or paper folded in half and pierced by the sinker posts to hold it in place.
8. On Passap, use modified stripper blades. See Reference Chapter 5.
9. On Superba, use the knitting retainer, with the front bed dropped.

TEXTURED PATTERNS IN INTARSIA SHAPES

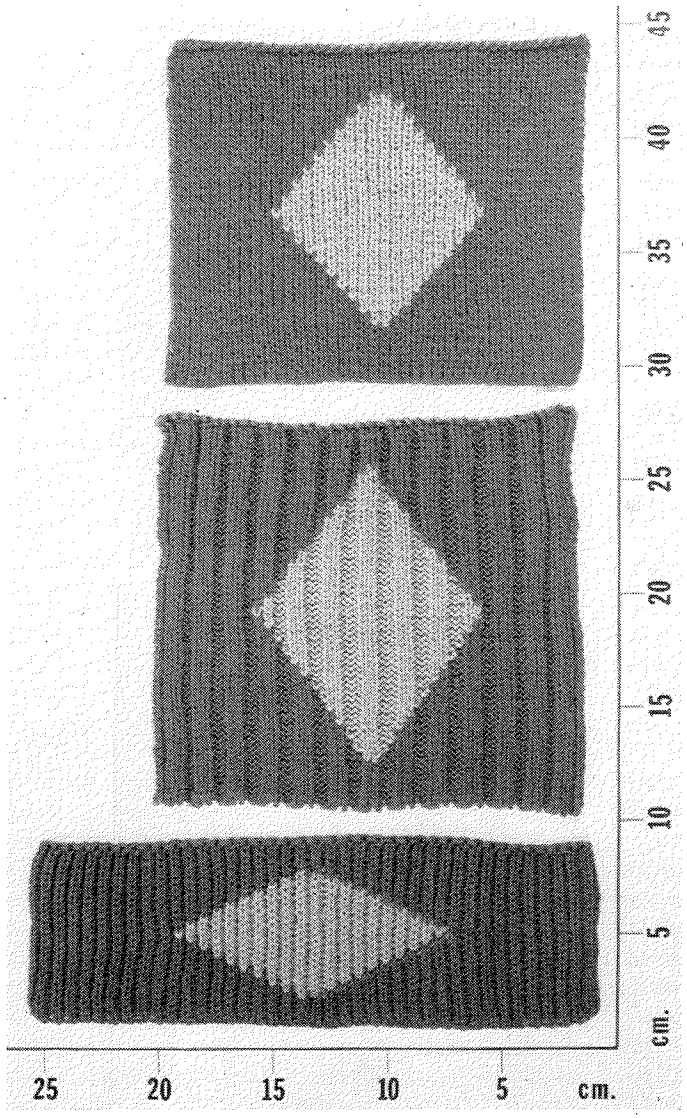
After you've developed some skill in knitting short row intarsia with stockinette, try knitting either the background or the shapes in a textured or jacquard pattern. Use a very small repeating pattern with either manual selection or a punchcard. If your pattern is one in which there is likely to be a sharp difference in gauge, such as a tuck or slip pattern combined with stockinette, try one of the following techniques to even things out. You can knit more rows of pattern than of stockinette; for example, knit four rows of slip stitch for every two of stockinette. Or use a thinner yarn for the stockinette, and a thicker yarn and larger stitch size for the pattern. On Passap, slip stitch or fairisle is easier to combine with short rows than is tuck stitch. Place needles for held stitches in NWP (in the blocking rail); the rest can be in WP/RP for the pattern. On all machines, when you take stitches out of hold while knitting a manual or punchcard pattern, be sure to arrange them in pattern, otherwise they will knit plain.



Short row diamonds knitted manually with intarsia Pattern 6. Single bed techniques.
Top. Plain diamond in stockinette.
Center. 1x1 tuck stitch diamond; SS one size larger than stockinette.
Bottom. Fairisle diamond; SS one size larger than stockinette.

DOUBLE BED INTARSIA

Short row intarsia can be knitted double bed by exactly the same method as is used on single bed. The fabric and pattern will be completely reversible. Simple ribs of various kinds can easily be knitted in intarsia. There are only two technical hints. First, frequent adjustment of weights on *both* sides of the fabric is absolutely essential in any double bed short row patterning. Passap's long length "heel grips" are recommended. Second, yarn tails must be brought down between the beds so they won't be knitted in accidentally. If there is a tail in the middle of the fabric, bring it down between the beds and put a clothespin or other clamp on it to hold it.

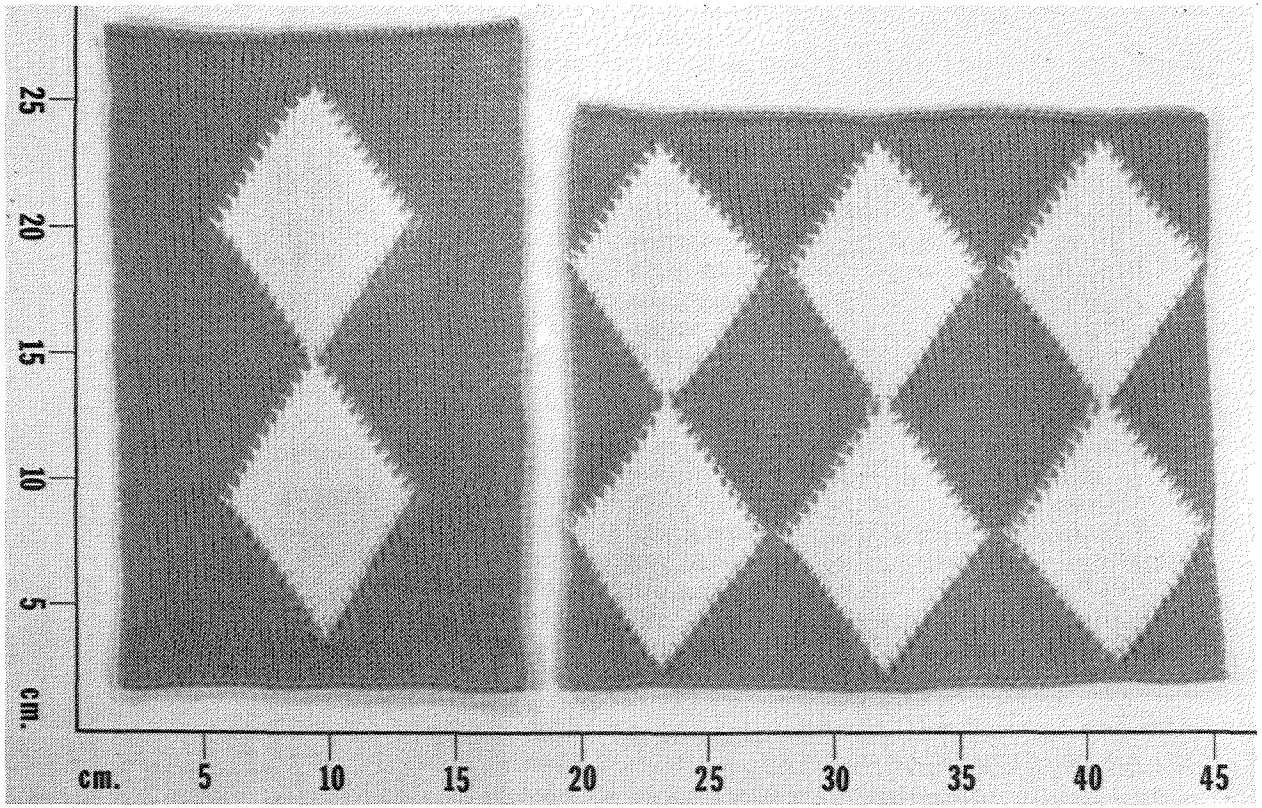


Double bed techniques.
Top. Knitted in full needle rib.
Center. Knitted in 2x1 rib (2x2 industrial rib).
Bottom. Knitted in full fisherman's rib.

KNITTING SHORT ROW INTARSIA WITH A PUNCHCARD

To knit an all-over pattern, or a motif which will fit the width of a punchcard, semi-automatic short row intarsia knitting in stockinette can be done on all machines. As an illustration, here the diamond pattern has been enlarged to fit the width of a card. On Brother/Knitking and Singer/Studio, plan the design so one repeat will fill the width. On Passap and Superba, knitting is easier if the repeat is an even division of 40 or 60. The knitting sequence is the same as in the diamond done manually. The carriage is set for slip in both directions; the punchcard rotates EOR. Isolation cams are used to isolate that portion of the knitting which contains the diamond, or the stitches to either side of the immediate knitting area can be placed in HP. In an all-over pattern, the isolation cams are shifted back and forth across the needle bed by one-half to one repeat, depending on the section being knitted. In a motif, the isolation cams remain stationary throughout; needles outside the punchcard area are brought into position manually. If you use the all-over card to knit a motif, the punchcard must be stopped, rolled back, and restarted so the background sections (B, C, E and F) can be knitted individually. This must also be done in the all-over pattern, to knit each diamond in turn across the width. The special motif card eliminates the roll-back. The numbers in the all-over diagram (overleaf) show the order in which each section is knitted. A separate yarn can be used for each vertical section (two gray and one white in the motif; four gray and three white in the all-over), or one yarn of each color can be cut at the end of each diamond and started anew.

The punchcards illustrated have been punched to knit an eyelet join automatically between sections, with the card rotating EOR. Wrapping can be done manually by catching the yarn in the hook of the adjacent needle after each RC1 or RC2. For a small eyelet join made automatically, the card may also be punched according to the method used on the punch-cards for the miter angle in the Short Rows chapter.



Short row diamonds knitted with punchcard. Left: Diamonds knitted as motifs. Right: Diamonds as all-over pattern.

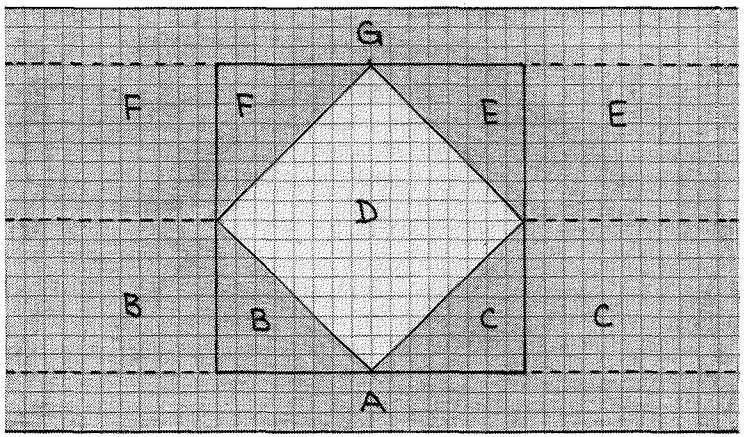
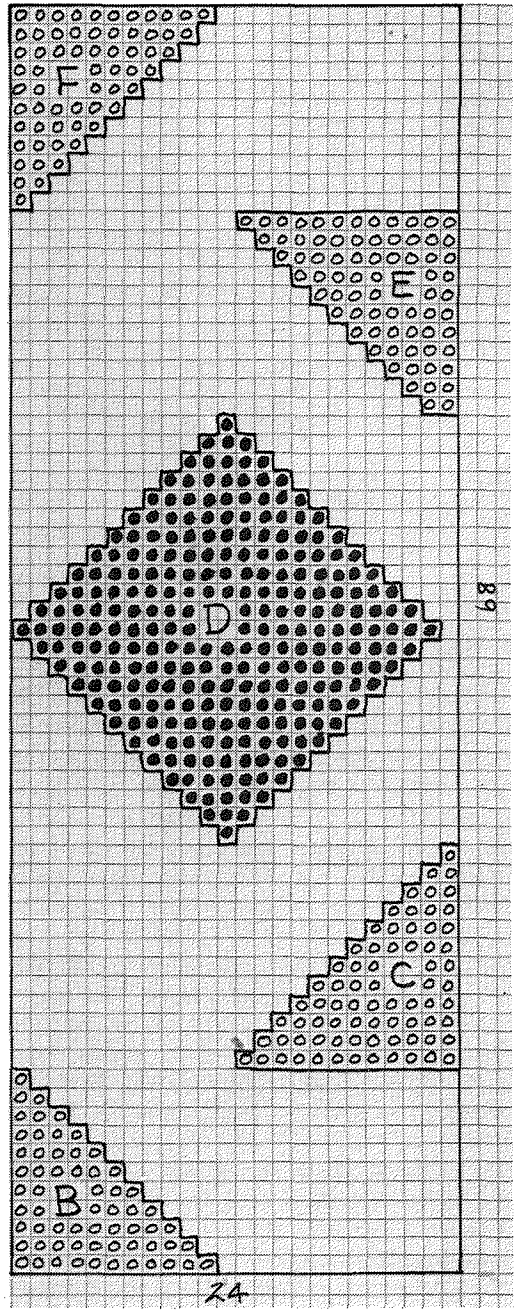


Diagram for knitting motif pattern with a punchcard. Include selvedge needles when knitting sections B, C, E, F.

Punchcard for knitting Pattern 6 as motif only, for Japanese machines. For Passap, design the motif to be 20 or 40 stitches wide; for Superba, 20, 30, or 60 stitches wide. The cards all will be punched in this same manner.



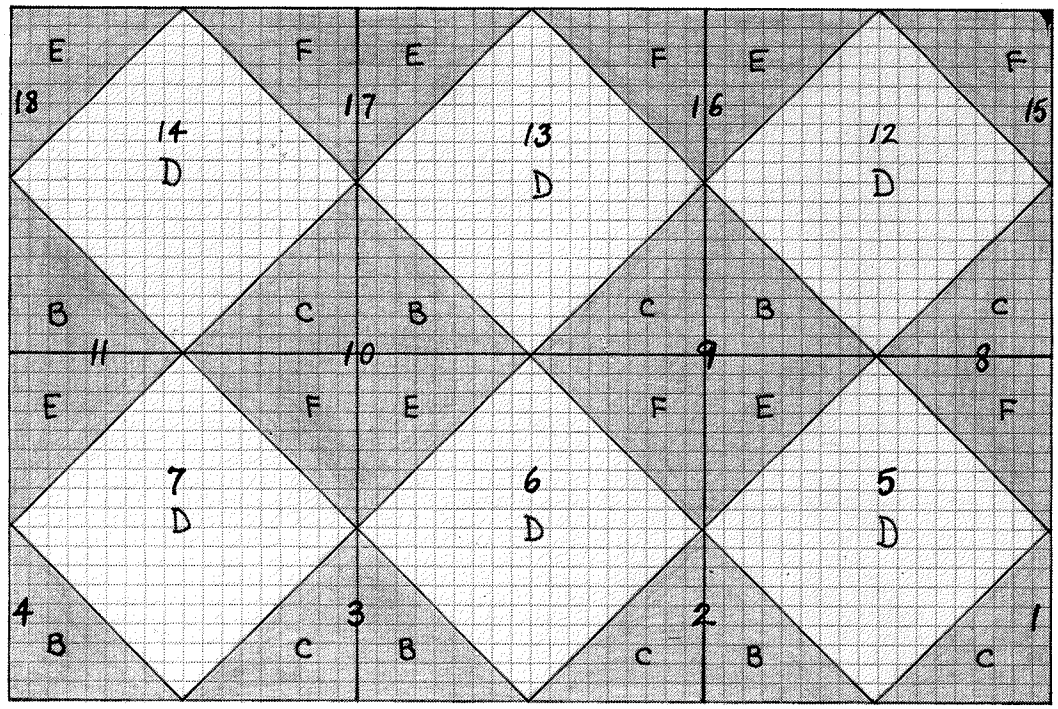
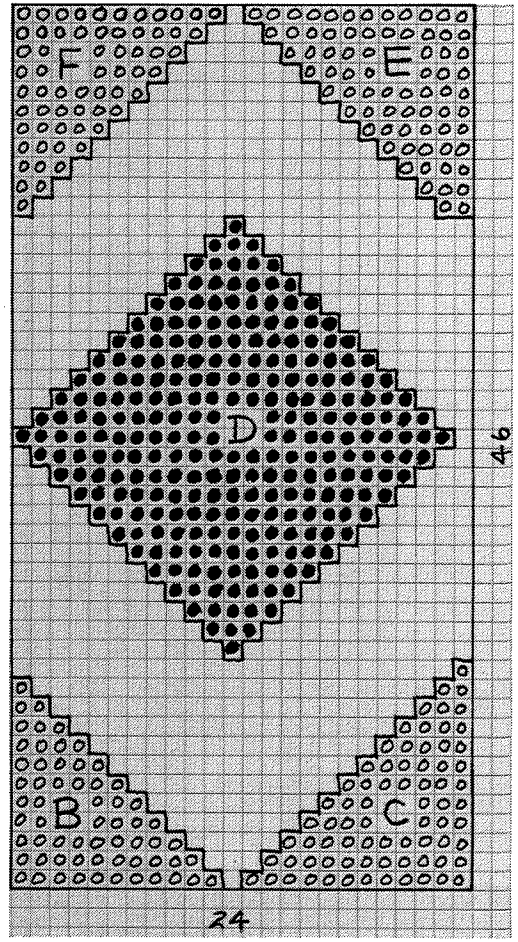


Diagram for all-over pattern, shown here 3 repeats wide and 2 repeats tall. Sections B and C, E and F are knitted together in color 1 (dark). Section D is in color 2 (light). The numbers indicate the order in which each diamond shape is knitted.



Punchcard for knitting Pattern 6 as an all-over design or as a motif, for Japanese machines. For Passap and Superba, follow the instructions with the punchcard diagram on the preceding page.

TAPESTRY OR BOBBIN KNITTING

This, of all the machine techniques for intarsia, affords the knitter the widest spectrum for patterning and thematic or pictorial designs. Any number of colors and yarn types can be combined in a row. The effects achieved in the previously described intarsia methods can all be done this way, too. But, because the inlay elements are knitted manually, this technique does require more time and patience than any of the others. For the knitter with any artistic bent or imagination, it allows for spectacular effects and minute detailing, and can resemble a painting or tapestry, much as needlepoint can.

Tapestry knitting is made single bed, in stockinette, and there is at least one method which is suitable for every machine. The design or pattern is usually drawn on paper first. It can be a line drawing, which is run through the charting attachment, with the stitch and row scale matching the gauge on your stockinette swatch. Or it can be a stitch by stitch graphed design, which can also be run through the charting attachment, with the stitch and row scale matching the squares on the gridded paper.

There are three common methods for tapestry knitting. You can decide for yourself which of the three best suits your design, yarn, and machine. In all three techniques, separate balls or bobbins of yarn are prepared for each color area across the knitting. The balls are lined up on the floor in front of the machine and the tail from each anchored at its starting place on the first row. All yarns are fed manually. Passap knitters should use modified blades for the black strippers, and in the first two techniques, each end of yarn must be threaded through a separate feeding eyelet. Also, disconnect the front carriage and use the back bed and carriage only.

TECHNIQUES FOR TAPESTRY KNITTING

1. Yarn in various colors and widely different kinds can be used to diversify the surface texture of the knitting. All yarns must be compatible—must shrink or stretch at the same rate—to avoid disaster when they are washed or cleaned.

2. If different kinds of yarn are used, determine the gauge and proper stitch size by testing. Make a swatch with a square or diamond shape in each kind of yarn to determine the one stitch size that will be suitable for all of them.

3. When using a pictorial design and working from a graph with a square grid, remember that the knit stitch is not square and therefore the proportions of the knitted design will be different from the graphed design. If one graph square equals one row, the design will be condensed; if one square equals two identically knitted rows, the design will be slightly elongated. To bring the design into proportion with the graph in a non-geometric pattern, we usually knit so that one square equals one row, with every fifth pattern row knitted twice.

4. Although we describe tapestry knitting as a way of making flat fabrics of many colors, three-dimensional effects with short rows can be incorporated in all three methods described below. Read the Short Rows chapter, then try knitting some of those fabrics using one of the tapestry techniques. If you own an accessory intarsia carriage, remember that it can handle short rows just as well as the main carriage can.

5. If you enjoy tapestry knitting but don't want to tie up your machine for long periods, it might be worthwhile to have a simple, older model machine just for manual work. If the tapestry knitting is to be part of a larger piece, it can be moved to your regular machine when it's complete. It isn't necessary to have a machine with the same needle spacing as your regular machine, as a swatch from each will tell you what stitch sizes to use on each to match gauges. Plenty of older Japanese 4.5 mm machines can be found at relatively low prices, and some of the newer "knitting frame" models are also suitable. Many of these machines lack yarn tension units and have carriages which move the needles into position just like the intarsia carriages do, as they were designed to have the yarn laid in the hooks manually.

TAPESTRY: METHOD 1

With the cams set for plain knitting, put the first color at the carriage side in the feeder. Move the carriage very slowly until you come to the point between the two needles where the first color stops and the next one begins. Remove the first yarn, allow it to hang down, and bring the second one up from *under* the first (so they cross) and put it in the feeder. Continue until it's time to change to the third color, and so on across the row. This method is suitable only if you can see clearly and have access to the point between two needles where the change occurs. On Brother/Knitking, the plating feeder is recommended instead of the usual feeder, as its shape allows greater visibility of the number strip and access to the needles. On machines where it's impossible to see the needle numbers, an extra needle number strip (purchased or homemade) can be taped somewhere on the back of the machine. Also tape an arrow mark on the back of the carriage exactly behind the yarn feeder. If you have a second bed, it is also possible on some machines to use its needle number strip.

This tapestry knitting technique can be very useful for following a line drawing (as opposed to a graphed design) which has been placed in the charting attachment. If you can see, or fix up a needle number strip on the machine, you can then follow the stitch strip on the charting attachment for yarn changing.

TAPESTRY: METHOD 2

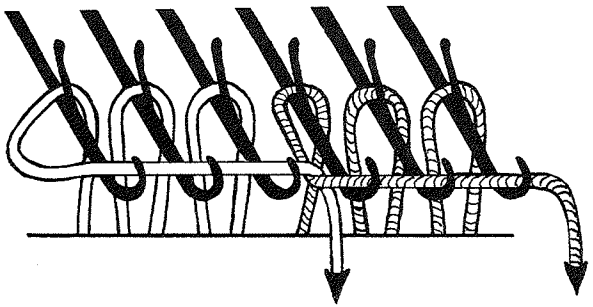
This method requires numerous passes of the carriage to get across a row, so it is best to turn off the row counter and/or trip cam to the charting attachment, and advance them manually. Set the carriage for slip in both directions. Each color area across the row knits one row separately from the other color areas, progressing from the carriage starting side to the opposite side. The carriage must back up after giving each area its one row, in order to select needles (or pushers) for the next area. With this technique there can be considerable wear and tear on the yarn, so fuzzy, soft yarn is not suitable. The procedure is as follows: thread the first color in the carriage, and place its needles (the first group on the carriage side) in patterning position. Knit across until the last needle of this group is cleared. Remove the yarn from the feeder by holding it straight down, then push the carriage a little more in the same direction. This will prevent mix-up of yarn in the brushes. Now back the carriage up (on Passap, put pushers in RP first), select the needles for the second group, and start across with the empty carriage. Just before the first needle of this group knits, cross its yarn under the first yarn and then place it in the feeder. Knit the stitches, then remove the yarn as before. Proceed across the row in this fashion with each color area. When the opposite selvedge has

been reached, there will be one complete row knitted. This method is useful when following a line drawing on the charting attachment, but where changing yarns between needles, as in method 1, is not possible.

TAPESTRY: METHOD 3

This is the most popular of the three methods for tapestry knitting, and can be done with or without an accessory intarsia carriage. This is the best method for knitting a very complex pattern from a gridded chart. The specific procedure for each machine is outlined below. These instructions are for tapestry knitting with the main carriage. To knit with the intarsia carriage, follow the instructions in its manual.

To knit, all needles are brought out to patterning position at the same time, far enough so that the stitches fall just *behind* the latches. The yarns are then laid across the open hooks, progressing from the carriage side to the opposite side. Each color is brought up from under its neighbor, to cross the yarns and hold the adjacent shapes together. Then the carriage knits the needles back to WP, all at the same time. The process is repeated for the next row. No yarn is fed through the carriage at all, so any number of colors can be knitted together in one row.



Tapestry, method 3. Laying yarn in hooks.

To begin knitting, using the main carriage, prepare the bobbins and/or balls of yarn. Knitting is done on the back bed, so lower the front bed as much as possible, cover it with a cloth or ribber cover, and bring the yarn ends from the balls up over it (not between the beds). Cast on the back bed with waste yarn, using a flat cast-on comb with wire. Knit enough with waste yarn so that the comb and weights will not interfere with the bobbins. Knit at least one row with the main yarn, remove it from the carriage, then begin knitting with the bobbins. Leave the tails hanging for the first row and weave them in on the second row. Or, prior to the beginning of the tapestry knitting, weave them in on the last row of plain knitting. You can give each yarn a little weight, to give proper tension and help keep the feeding ends in their proper order. Pennies taped to bobbins, or clothespins on the yarn coming from balls (clipped on near the floor), will do very nicely. Or you can simply give each yarn in turn a little tug as the carriage knits it, for tension.

Passap. Use the black strippers, comb and weights. After the waste yarn section, uncouple the carriages and leave the front carriage at the left side throughout, as it is not used. Remove the feeding eyelet, because it can damage the needles when it is empty. Set cam to BX, no pushers. *With pattern ruler, push all needles up so that stitches fall against the sinker posts *just behind* the latches. Lay the yarns across the open hooks. Push the needles back with the ruler just far enough so the latches close over the yarn in the hooks. Move the carriage across slowly.* Repeat for each row. Tapestry knitting with this technique is limited on Passap because of the way the needles move as the carriage knits them back, making it difficult for the yarn to slide through the hooks. It is most successful using a smooth, almost slippery yarn, a stitch size no larger than 6, and limiting the number of needles per color to 5 or 6.

Superba. Knit enough with waste yarn so that the comb and weights can be lifted to rest on top of the front bed, together with bobbins and ends from balls. Needles are moved to position 2 or 3 with a pattern ruler so the stitches fall just behind the latches. Or they can be moved to position 3 automatically by the following means: turn on the selection box (no card needed). Set switch 2 to negative reverser, switch 3 to ER or EOR, switch 4 to middle or lower position. Place cursor stops outside the selvedges. Set carriage for slip. *Put needle return buttons in upper position, RC2. Needles are now in position 3. Give a little tug on the comb to pull the knitting forward so the stitches will lie *just behind* the latches. Lay the yarn across the hooks. Give another little tug on the comb to close the latches over the yarn. On the side the carriage will move, put the needle return button in lowest position, RC1. Needles have knitted back and are now in position 1.* Repeat for each row.

Brother/Knitking. Knit enough with waste yarn so that the comb and weights can be brought forward to rest on top of the ribber together with bobbins and yarn ends. Remove the sinker plate from the carriage, set cams either to plain or both part buttons, HCL-N. *With pattern ruler, push all needles either to just beyond D position (stitches just *behind* the latches), or out to E position, in which case you must give a little tug on the comb to bring the stitches just behind the latches. Lay the yarns across the open hooks. Pull the knitting forward, by pulling on the comb, to close the latches over the yarn in the hooks. Move the carriage across to knit the needles back.* Repeat for each row. As an aid to pushing the needles forward each row, set the change knob to KC (no card needed) and the needles will be brought forward automatically to D position. A little push with the pattern ruler is still necessary to make the stitches fall behind the latches.

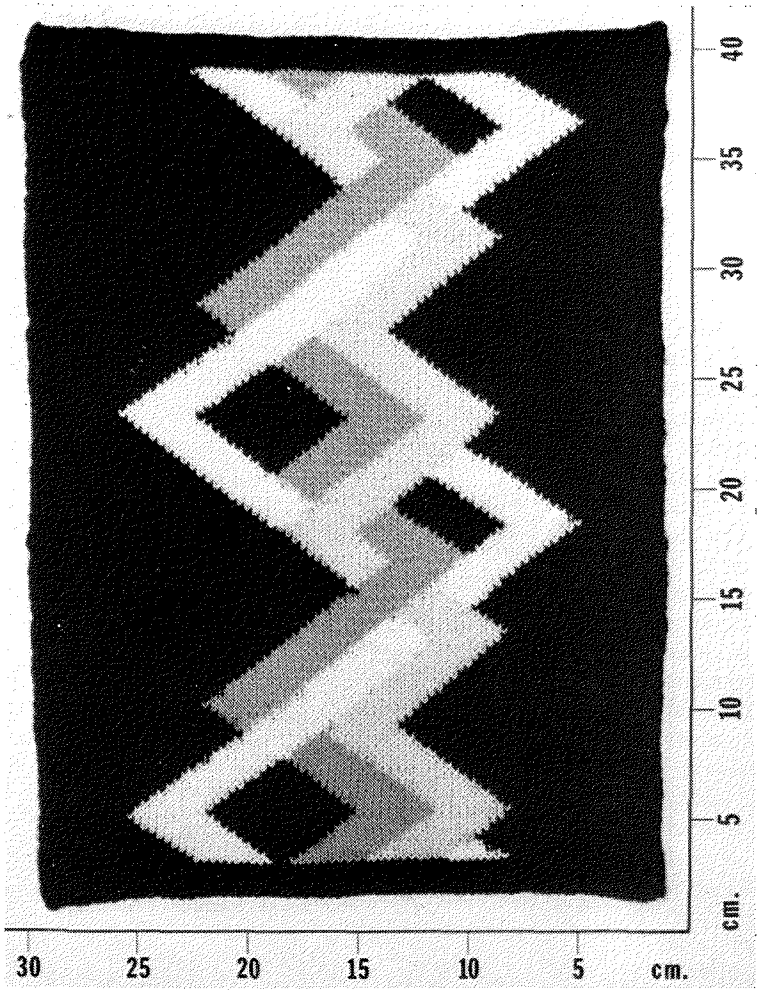
Singer/Studio. Knit enough with waste yarn so the comb and weights can be brought forward to rest on the cloth together with the bobbins and yarn ends. Remove the sinker plate from the carriage, set the cam to stockinette or slip, side levers back. Needles can be pushed out to C or D position on each row with a pattern ruler, or they can be brought out to C position automatically as follows. Lock the card reader (no card needed). *Press the carriage release lever so that the lid opens. RC2 with the lid open (brings needles to C position with stitches just behind latches). Lay the yarns across the needle hooks. Pull the knitting forward by pulling a little on the comb, so the latches close over the yarn in the hooks. Close the lid and move the carriage across (RC1) to knit the needles back to B position.* Repeat for each row.

Technical tips for all machines.

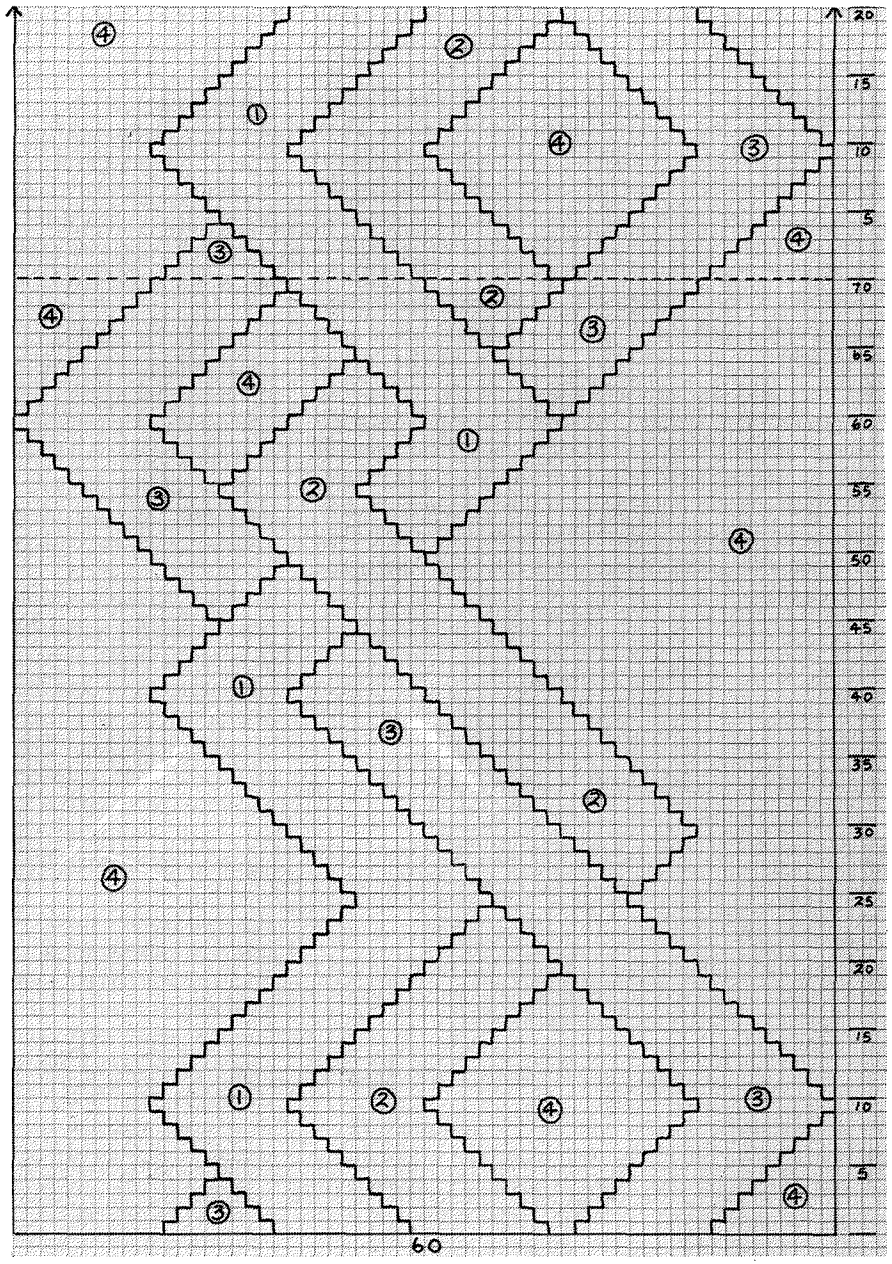
If you are moving needles forward to patterning position with a pattern ruler, try using instead a straight edge long enough to move them all forward all at once. This will save time and keep the needles even.

When you start or finish a color section, or when you move a color several needles over, use the following weaving techniques to work in the tails of yarn. To weave ends in, after the yarn is laid across all the hooks, move the ends under one needle and over one needle

two or three times. Let the yarn hang until one or two rows are knitted, then clip it off. To move a color to another nearby section, do the same kind of weaving, until the proper needle is reached, *before* the yarn is laid across the hooks. The yarn won't be noticed on the front of the fabric unless the weaving is overdone. When possible, try to weave a color over needles of the same or a similar color. You can also weave a color vertically for a few rows if, for example, a color shape ends and begins again nearby a few rows later. Just wrap the yarn over a needle EOR to carry it upward to where it will be used again.



Tapestry knitting and tapestry weaving. Chart for swatch in photo at left. Color 1 -light, color 2 - medium, color 3 - dark, color 4 - white. One repeat = 60 stitches and 70 pattern rows.



THE INTARSIA CARRIAGES

An accessory intarsia carriage is available for all machines except Passap. These very simple carriages consist of a small cam box with one cam track, a stitch size dial, and a little sinker plate. Their intended use is for the tapestry knitting described in method 3. They are very handy indeed, eliminating the manual effort required to bring needles forward every row. They bring the needles forward with the stitches just behind the latches, with the latches open. You must lay the yarn in the hooks exactly as described above, but without closing the latches. The carriage will then knit the needles back and at the same time bring them forward again, with the stitches just behind the latches, to receive the next row of yarn. All of them can be used with double bed, with the front bed in the lowest position out of the way, and the yarn ends brought up *between* the beds. It is also possible to use both the main carriage and the intarsia carriage in the same piece of knitting, but you must be sure the stitch gauges match. The stitch size dials may not be calibrated exactly, and the tension you give the intarsia yarns may not be the same as the yarn tension unit gives the main yarn in the main carriage.

CHAPTER 10
Short Rows

So far, we've concentrated primarily on fabric structure and textural designs within the fabric rather than shaping the fabric itself. Now we are going to explore the technique of knitting short rows (*partial knitting, graduations*) to knit both flat and relief fabrics.

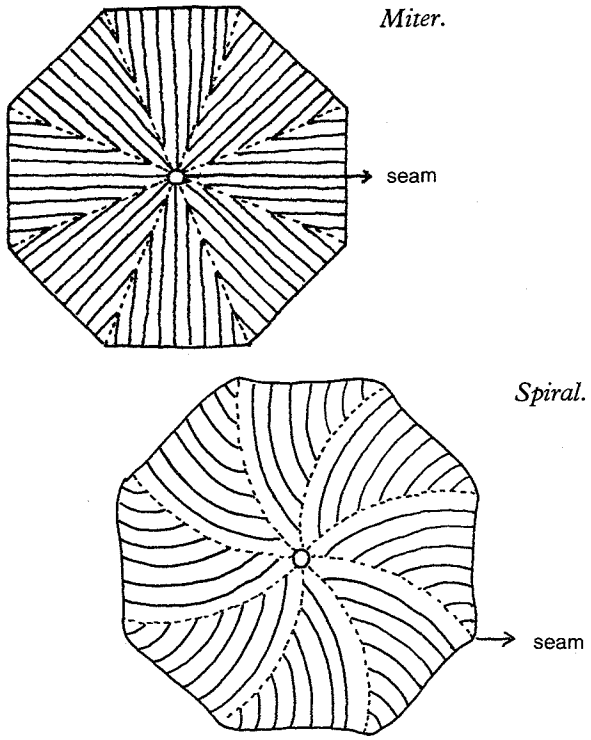
Most knitters probably think of short row knitting as a technique used mainly for garment construction—skirt darts, shaping necklines and shoulders, hemlines and sock heels—or as one way to knit intarsia. There is much more to it than that. Short rowing can also be used to build a whole fabric with individual shapes, either embedded as flat designs with diagonal stitches, or rising up as three-dimensional configurations like peaks and hills.

We will demonstrate the principles of short row shaping, both manually and with a punchcard, by showing how to knit a series of simple geometric shapes. The concepts and techniques for knitting these shapes are the same as those used for shaping parts of garments, and we hope this chapter will give you a better understanding of how to use short rows for designing garment shapes as well as for creating shapes in the fabric itself.

In essence, short rowing means knitting a row of stitches part way across the fabric, turning, and knitting back; then knitting an even lesser number of stitches across, turning back, and repeating, decreasing the number of stitches each time. The technique also works in reverse: beginning with a small number of stitches and increasing the number each row. The result is a fabric with more rows knitted at one selvedge than at the other. This is the technique used, for example, to knit a wedge-shaped panel in a sideways-knitted skirt.

Short rowing can be done by either of two methods. You can put into holding position the needles that you do *not* want to knit in each row, with the holding cam on the carriage set for hold, then continue to knit over the needles in working position (the usual manual method). Or, with the cams set for slip, put into patterning position the needles you *do* want to knit in each row, while the rest of the needles remain in working position and do not knit (the usual punchcard method).

Now, if you knit some short rows beginning with the entire width of the fabric, then shortening gradually to one selvedge as discussed above, and then *either* continue knitting plain across all the needles *or* short row in the opposite direction, there will be a mark across the knitting width where the slant of the stitches changes direction, and an angle will be created at each selvedge. If you knit plain across all needles after short rowing, the angle and mark will form a curve, or *spiral angle.* If you short row in the opposite direction instead, the angle and mark will form a straight, or *miter angle.* When several of these angles are knitted one after the other, the result is a geometric shape with a small hole in the center and one seam to join, as indicated in the sketch.



Octagons viewed from the purl side.

To recapitulate, the joint of each angle, that is, the mark where the knit stitches change direction, is made by manually putting one needle or group of needles into holding position, knitting one or more rows across the remaining needles, putting the next needle or group into holding position, knitting one or more rows,

and so on, until all the needles are in holding position. Then, immediately begin short rowing in the opposite direction to make a miter angle, or, for a spiral angle, knit one row across all needles and begin the short rows again in the *same* direction. The total number of needles cast on in the beginning makes one-half the width of the shape, so you are actually knitting around the radius of the shape.

A *spiral* angle is made by moving groups of needles into holding position in *one direction only*. Hence, when all the needles are put back into working position and again taken to holding position from the *same direction*, a pinwheel or spiral form emerges. Spiral angles are used where a soft, less well defined angle is desired, as in a bust dart or a round beret.

A *miter* angle is made by moving groups of needles in *opposing directions*. Thus, if groups of needles are put into working position in reverse of the order in which they were taken out (the last ones out to holding position are the first ones back to working position), with one or more rows of knitting between the groups, a mitered figure is formed. Miter angles are used where a sharp, well defined angle is desired, as in a sock heel or for corners in knitted bands and facings.

The same angle, incidentally, can be made by moving the needles in reverse, that is, from holding position to working position and back to holding position. This can also be done with a spiral angle, since it is really either the first or second half of a miter angle. The kind of knitting being done (double bed or single, jacquard, tuck, lace, or weaving) will more or less determine which method is more suitable.

If many angles are to be made in succession in stockinette fabric, the manual effort of putting needles in and out of holding position can be eliminated using a punchcard to select the needles, with cams set to slip. This will be discussed at the end of this chapter.

Spirals and Miters with angles of various sizes.

Most stitch patterns, whether plain or fancy, are based on simple arithmetic—adding and/or subtracting and maybe multiplying or dividing the number of stitches and rows. Patterns and textures occur when the order of needle movements and colors are repeated at regular intervals.

Like stitch patterns, patterns made with miters and spirals also result from systematically repeating a progression. Since we are working with geometric shapes as examples, the chief concern with repeating needle movements is in controlling the size of an angle in order to create a flat polygon with the desired number of sides and angles.

On the facing page is a chart of formulas indicating, for various polygons, the number of needles moved in or out of holding position and the number of rows knitted between needle movements, to make angles of various sizes. the formulas are for stockinette only. For other kinds of knitting, make a swatch to determine what adjustments are necessary. The total number of needles moved in a given number of knitted rows is noted at the top of each box in the chart. The number can be divided up as you wish. For example, to make a triangle with mitered angles, you move four needles every six rows. You can move all four together every RC6 or divide them as suggested in the box.

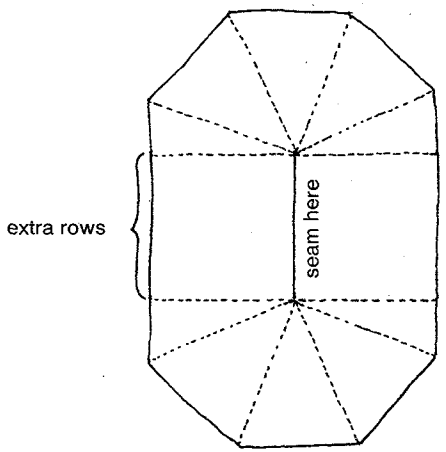
The formulas are given for one angle of the polygon. When repeated, one right after the other, they make perfectly flat geometric shapes. The angle is simply knitted the necessary number of times to produce that particular shape.

We are not including the formula often used by knitters to make squares (or 90° angles): one needle moved, RC2. This formula does *not* make a true 90° angle in stockinette, but one closer to 75°, and squares made according to that formula must be blocked to 90° angles. As long as you are aware of the problem, there is no reason not to use this formula, because it is so convenient for automatic wrap, easy to remember, and can make a nice, even row of eyelets.

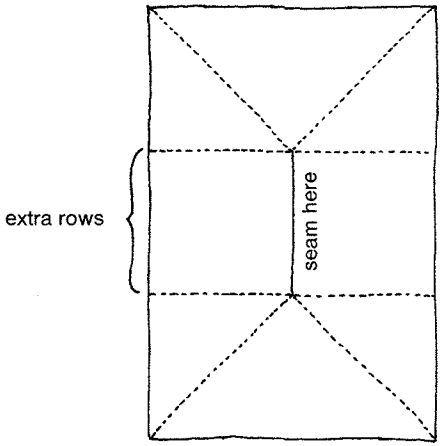
Variations can be made on these basic shapes. The formula for a polygon with X number of angles can be applied to another polygon to make it either convex or concave. The same effect can be achieved by knitting more or fewer angles than called for. Also, two different formulas can be used at once by knitting the first half of a mitered angle in one formula and the second half in another. Any of these variations will make a shape with ruffled edges at one extreme, or a cone-shaped center at the other.

Frames with large holes in the center can easily be made by adding extra rows of plain knitting *between* each angle. Elongated shapes, such as ovals and rectangles, are formed by knitting extra rows between two angles on opposite sides only.

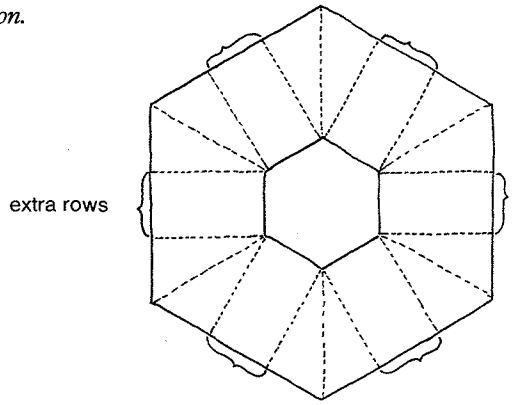
Octagon.



Square.



Hexagon.



FORMULAS FOR POLYGONS
KNITTED AROUND THE RADIUS WITH SHORT ROWS
(STOCKINETTE STITCH)

Number of angles	Angle at center of shape / Angle at outside point of shape	Repeat formula for miter, wrapped or with eyelets (# ndls moved each group):	Repeat formula for spiral, wrapped or with small eyelets (# ndls moved each group):	Repeat formula for spiral, large eyelets (# ndls moved each group):
3 triangle	120°/60°	move 4 ndls every 6 rows *1 ndl, RC2; 1 ndl, RC2; 2 ndls, RC2*	move 4 ndls every 12 rows *1 ndl, RC4; 1 ndl, RC4; 2 ndls, RC4*	move 4 ndls every 12 rows *1 ndl, RC4; 1 ndl, RC4; 2 ndls, RC4*
4 square	90°/90°	move 3 ndls every 4 rows *1 ndl, RC2; 2 ndls, RC2*	move 3 ndls every 8 rows *1 ndl, RC4; 2 ndls, RC4*	move 3 ndls every 8 rows *1 ndl, RC4; 2 ndls, RC4*
5 pentagon	72°/108°	move 2 ndls every 2 rows *2 ndls, RC2*	move 1 ndl every 2 rows *1 ndl, RC2*	move 2 ndls every 4 rows *2 ndls, RC4*
6 hexagon	60°/120°	move 8 ndls every 6 rows *2 ndls, RC2; 3 ndls, RC2; 3 ndls, RC2*	move 4 ndls every 6 rows *1 ndl, RC2; 1 ndl, RC2; 2 ndls, RC2*	move 8 ndls every 12 rows *2 ndls, RC4; 3 ndls, RC4; 3 ndls, RC4*
8 octagon	45°/135°	move 3 ndls every 2 rows *3 ndls, RC2*	move 3 ndls every 4 rows *1 ndl, RC2; 2 ndls, RC2*	move 3 ndls every 4 rows *3 ndls, RC4*
10 decagon	36°/144°	move 4 ndls every 2 rows *4 ndls, RC2*	move 2 ndls every 2 rows *2 ndls, RC2*	move 4 ndls every 4 rows *4 ndls, RC4*
12 dodecagon	30°/150°	move 16 ndls every 6 rows *5 ndls, RC2; 5 ndls, RC2; 6 ndls, RC2*	move 8 ndls every 6 rows *2 ndls, RC2; 3 ndls, RC2; 3 ndls, RC2*	move 16 ndls every 12 rows *5 ndls, RC4; 5 ndls, RC4; 6 ndls, RC4*
16 hexadecagon	22.5°/157.5°	move 6 ndls every 2 rows *6 ndls, RC2*	move 3 ndls every 2 rows *3 ndls, RC2*	move 6 ndls every 4 rows *6 ndls, RC4*

TECHNIQUES FOR KNITTING SHORT ROW SHAPES

1. All the shapes shown here are knitted in stockinette.
2. All shapes with the same number of cast-on stitches will have the same radius; different formulas produce only the size and number of angles, not the final dimensions of the whole shape, which depend upon the number of stitches cast on.
3. To achieve the same number of rows per angle, spirals must have half the number of needles moved per needle group as miters, in proportion to knitted rows between groups, because shaping occurs only once per angle. In miters it occurs twice per angle. Conversely, there must be double the number of rows between groups in spirals than in miters. Note this on the formula chart. In mitered angles be sure to move the *same* group of needles in both directions, or simply reverse the formula for the second half of the angle.
4. Cast on and off with waste yarn, and graft the seam together to complete the shape. The center hole can be gathered closed and blocked flat, or covered with a button or other decoration.
5. Be sure you understand how to set your machine for holding position and how to move individual needles in and out of that position.
6. Adjust weights every few rows.

PREPARATION FOR KNITTING THE POLYGONS

1. Select the shape you want to make and note its formula on the chart.
2. Put into working position needles for half the total width of the shape, or the number you want for the radius. It is easiest to use a multiple of the needles per group.
3. Cast on with waste yarn and knit several rows.
4. Set cams for stockinette and holding position.
5. With main yarn, knit one row. Choose a technique from those given below, and you are ready to begin the sequence. The outer edge of the shape will be on the same side as the carriage starting point. The carriage always begins and ends knitting each angle from the same side. When enough angles are completed to form the shape, remove on waste yarn and graft the beginning and end together.
6. In each technique below, if the polygon shape

begins and ends *between* two angles, it also begins and ends with needles in WP. If the polygon shape begins and ends at the *center* of the angle, it begins and ends with needles in HP.

7. Automatic wrap cannot be knitted on Passap. When directions call for "needles in WP," on Passap the *pushers* are in WP. "Needles in HP" means pushers in RP. When one needle of a group goes into HP after RC1, it means that needle will be wrapped when the second RC1 is knitted. Passap knitters must instead put all the pushers called for into RP, knit one row, place yarn in the hook of the adjacent needle, then knit the second row.

POLYGONS WITH MITER,
OR STRAIGHT, ANGLES

Solid miter with automatic wrap in one direction. This miter will show a slight spacing between needle groups, giving a textured appearance.

For a polygon beginning and ending between two angles:

Step 1. Place ndls in WP. *On the side opposite the carriage, put all ndls except the last one (on the carriage side) of the first group in HP, RC1. Put the last ndl of this group in HP, RC1.* Repeat with subsequent groups until all ndls are in HP. If there is only one ndl in a "group," knit RC1, put ndl in HP, RC1.

Step 2. *On the same side as the carriage, begin putting whole groups of ndls in position to knit back, RC2.* Repeat until all ndls are in WP. There is no wrapping in this direction.

Repeat both steps.

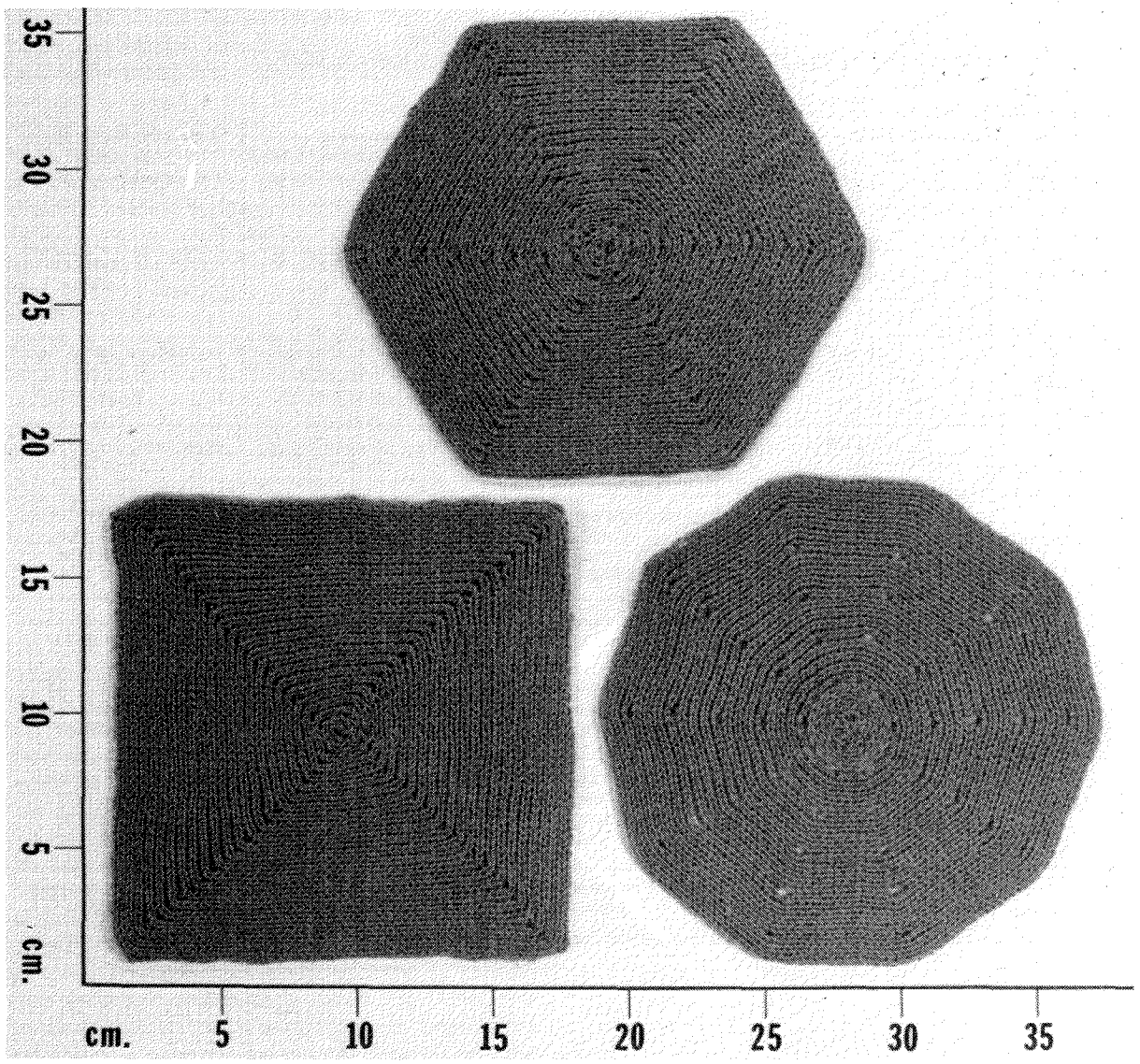
For a polygon beginning and ending at the center of the angle:

Step 1. *Have all ndls in HP. On the same side as the carriage, put groups of ndls in position to knit, RC2,* (there is no wrap in this direction) until all ndls are in WP.

Step 2. *On the side opposite the carriage, put all except the last ndl of the first group in HP, RC1. Put the last ndl of this group in HP, RC1.* Repeat with subsequent groups until all ndls are in HP.

Repeat both steps. At the end of the knitting, knit one row.

Solid miter with automatic wrap in both directions. This miter will be smooth, with no visible markings at the turn of the angle.



Polygons with miter angles.
Top. Solid miter with automatic wrap in one direction, 6 angles.
Bottom left. Solid miter with automatic wrap in both directions, 4 angles.
Bottom right. Eyelet miter, no wrap, 10 angles.

For a polygon beginning and ending between two angles:

Step 1. Put ndls in WP. *On the side opposite the carriage put all but the last ndl of the first group in HP, RC1. Put the last ndl of this group in HP, RC1.*

Step 2. With all ndls in HP, *on the same side as the carriage, put all ndls of the first group in position to knit, RC1. Put the last ndl of this group back to HP, RC1. Put the next group of ndls, plus the last ndl of the previous group, in position to knit one row.*

Repeat both steps.

For a polygon beginning and ending at the center of the angle: Begin with the second step above, followed by the first step above. At the end of the polygon, knit one row over all needles.

Eyelet miter. There is no wrapping involved in making eyelets. Move all the needles in the group together, in both directions.

For a polygon beginning and ending between two angles:

Step 1. Put all ndls in WP. *On the side opposite the carriage, put all ndls of the first group in HP, RC2.* Repeat until all ndls are in HP.

Step 2. With all ndls in HP, *on the same side as the carriage, put groups of ndls in position to knit, RC2.* Repeat until all ndls are in WP.

Repeat both steps.

For a polygon beginning and ending at the center of the angle:

Step 1. Put all ndls in HP. *On the same side as the carriage, put groups of ndls in position to knit. RC2;* until all ndls are in WP.

Step 2. With all ndls in WP, *on the side opposite the carriage, begin putting groups of ndls in HP, RC2* until all ndls are in HP.

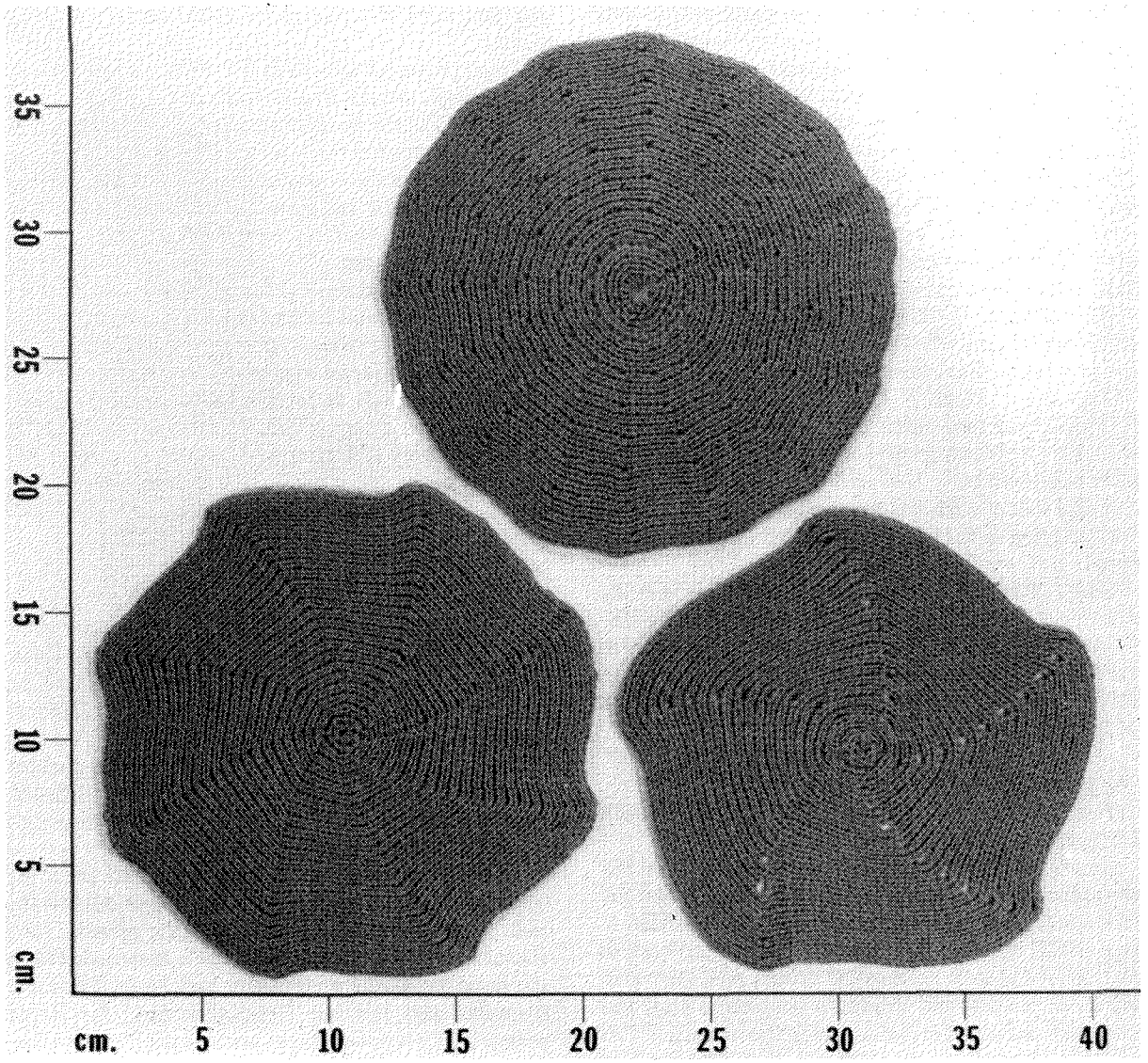
Repeat both steps. After the polygon is completed, knit one row.

POLYGONS WITH SPIRAL, OR CURVED, ANGLES

In polygons with eyelets or shaping at the *end* of each angle, the spirals "rotate" in the opposite direction from those in polygons with eyelets or shaping at the *beginning* of each angle.

Spiral with small eyelets (no wrapping). For a polygon with eyelets at the end of each angle:

Step 1. Put all ndls in WP. *Set cams for HP.



Polygons with spiraled angles.
Top. Spiral with small eyelets, no wrap, 16 angles.
Bottom left. Solid spiral with automatic wrap, 8 angles.
Bottom right. Spiral with large eyelets, 5 angles.

Beginning on the side opposite the carriage, put ndls for each group in HP, RC2 after each,* until all ndls are in HP (carriage is at starting side).

Step 2. Change cam to knit all ndls back to WP, RC2.

Repeat both steps.

For a polygon with eyelets at the beginning of each angle: set cam for HP throughout.

Step 1. Put all ndls in HP. *Starting on the same side as the carriage, put each group of ndls in position to knit, RC2* between each group.

Step 2. After the last group is in position to knit, RC2 over all ndls. This will bring the carriage back to the starting position for the next angle.

Repeat both steps.

Three- and four-sided polygons must be worked with RC4 between groups instead of RC2, and will have large eyelets.

Solid spiral with automatic wrap. For a polygon with shaping at the end of each angle, make a ridged spiral:

Step 1. Put all ndls in WP. *Set cam to HP. On the side opposite the carriage, put all but the last ndl of the first group in HP, RC1. Put the last ndl of this group in HP, RC1.* Repeat with each group until all ndls are in HP. If there is only one ndl in a "group," knit RC1, put ndl in HP, RC1.

Step 2. Change cam to knit all ndls to WP, RC2.

Repeat both steps.

For a polygon with shaping at the beginning of each angle, make a smooth spiral:

Step 1. Put all ndls in HP, with cam set for HP throughout.* Beginning on the same side as the carriage, put all ndls in the first group in position to knit, RC1. Put the last ndl of this first group back to HP, RC1. Put ndls for the next group, plus the ndl in HP from the previous group, in position to knit, and knit them all together, RC1. Bring the last ndl of this group back to HP in the same manner as for the first group, RC1.* Continue across the bed.

Step 2. On the last group, knit one row as usual, then one row across all ndls.

Repeat both steps.

There is an alternate method to the one described above. The spiral rotates in the same direction as the smooth spiral, but is ridged, as is the polygon with shaping at the end of each angle. The outer edge of this polygon is on the side *opposite* the carriage starting point.

Step 1. First put all ndls in WP. *On the same side as the carriage, put the first ndl only of the first group in HP, RC1. Put the remaining ndls of this group in HP, RC1.* Repeat until ready for the last group. (If there is only one ndl in a group, put it in HP, RC2.)

Step 2. On the last group, put up the first ndl as usual, knit RC1, then one row over all ndls.

Repeat both steps.

Polygons with three and four sides are worked with RC4 between groups instead of RC2. The same needle must be wrapped twice to prevent eyelets.

Spiral with large eyelets. These are worked by the same methods as for spirals with small eyelets, except that the groups are doubled in number and RC4 is knitted between groups, because four rows are required at the same needle selection to make a large eyelet. Three- and four-sided shapes have the same grouping and RC as before.

KNITTING THE POLYGONS DOUBLE OR IN THREE DIMENSIONS

So far, we've described how to make miter and spiral angles to form flat polygons. The polygons *can* be knitted double to make two-sided, three-dimensional shapes. Such forms are actually composed of two identical polygons knitted as one piece, with purl (or knit) sides facing each other. The only seam will be the usual graft along the radius from one center around to the other center across both shapes.

When these forms are knitted, the centers are at the selvedges and the angled points in the middle of the bed. When taken off the machine, the selvedges are folded into the center and the shape is flattened. This is the same technique used to knit sock heels. The same formulas and knitting techniques used for single polygons are applied here, with two of them being knitted at once. Thus, twice as many needles must be cast on—half for each face of the shape. The needles are moved alternate sides each RC1, which in effect makes RC2 between the groups of needles on each face.

Miter.

To make a miter shape with eyelets or with wrap:

Step 1. Needles begin in WP and are brought to HP beginning with the side opposite the carriage, from each selvedge to center, alternating sides each RC1.

Step 2. Needles are put back in WP on the same side as the carriage, from center to each selvedge, alternating sides each RC1.

To make a miter by the reverse of the above method:

Step 1. Needles start in HP, are put in WP on the same side as the carriage from the center outward, alternating sides each RC1.

Step 2. Needles are brought back to HP on the side opposite the carriage from both selvedges toward the center.

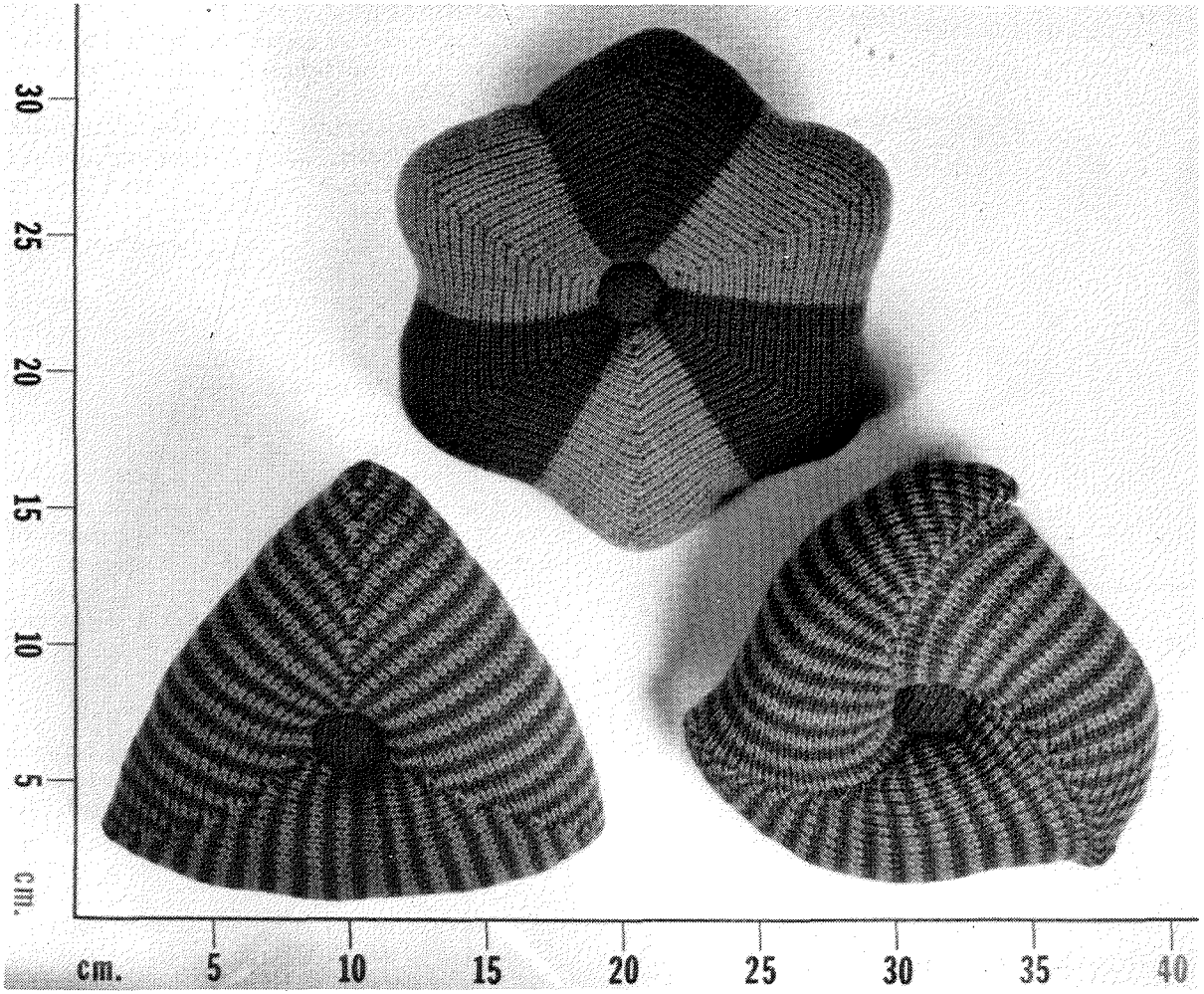
There will be one extra row of knitting on half the needles at the beginning and end of the knitting, because the *yarn must start and end in the center of the bed.* For example, knit with the waste yarn, then knit one row over all needles. On the side opposite the carriage, put half the needles in HP, knit one row over the remainder, then put these in HP.

Spiral.

Use the first miter method given above. Needles start in WP and move to HP from selvedges to center. After all ndls have been moved to HP, the yarn will be in the center of the bed and must knit half the needles back to WP. Then knit one row over all ndls to start the next angle. When knitting half the needles back, do so on alternate sides of the knitting each repeat, so one face of the polygon will have the same number of rows as the other face.

A second method is exactly the reverse of that described above, with the needles starting in HP. Here, the yarn must be in the center to start, which means knitting a row over half the needles, then putting these needles in HP, in order to start each panel.

For squares and triangles, which have RC4 between needle movements instead of RC2, knit RC2, moving needles on alternate sides as usual, then another RC2 at the same selection.



Polygons knitted double and stuffed to make three-dimensional forms.
Bottom left. Mitered triangle with wrapping, 2 rows each color.
Bottom right. Spiral triangle with wrapping, 2 rows each color.
Top. Miter with wrap in both directions, the star pattern. Knitted with 6 angles, but with formula for 5 angles. Change color each repeat. Made over width of 48 ndls with each side shaped up to center 8 ndls. Change SS every RC4. See description in adjacent text.

Using the three-dimensional shapes.

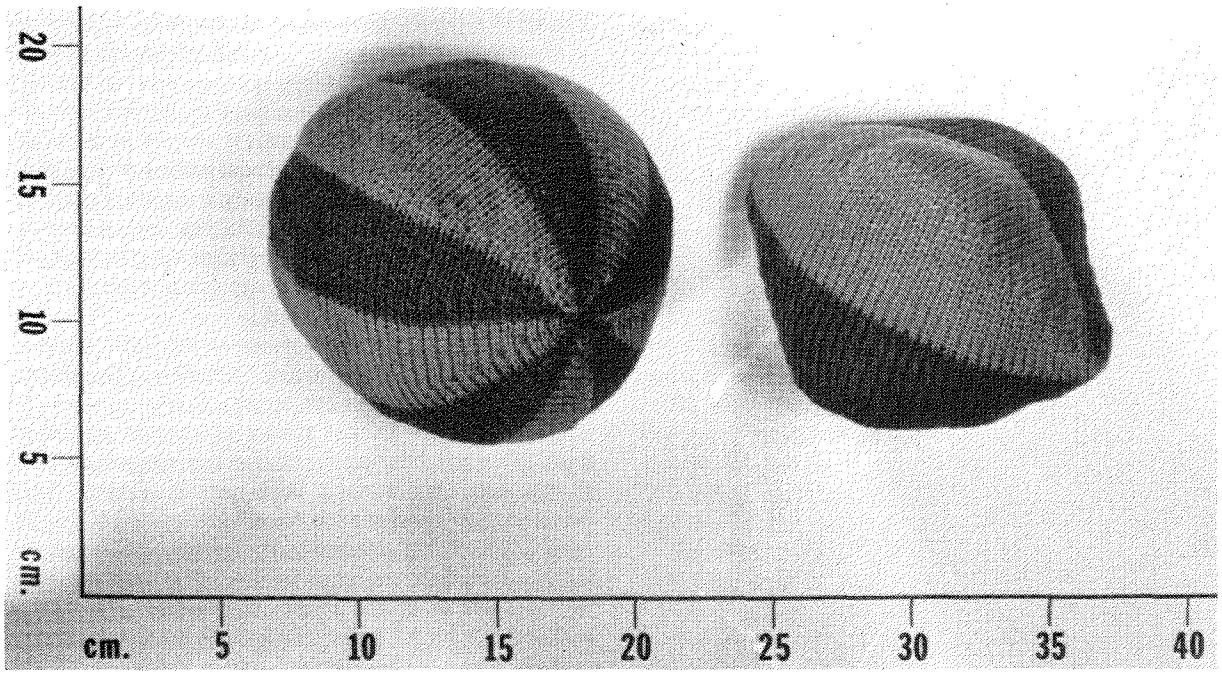
Once you understand the basic short row techniques for knitting three-dimensional shapes, you can modify them to suit the needs of a design. For example, in a ski hat knitted sideways, the crown is shaped by knitting either a mitered or spiral short row section on one side of the bed only. To make the body and cuff of the hat, the rest of the needles knit without shaping. A beret is shaped exactly like the double polygons just described, with half or more of the needles missing on one face to make a large hole for the head.

Horizontal darts on bodices are knitted with needles at both selvedges short rowing. Needles in the center continue knitting without shaping.

Sock heels are knitted the same way, on a smaller scale. The adjacent photo of the star-shaped swatch shows one way a sock heel can be varied. The beginning and end of each "heel" are knitted at a tight stitch size. Then gradually the stitch size becomes larger, so at the turning of the heel (the mark btween the two halves of the miter), it is quite large. This makes the "points" bulge a little from the area between to make a star. Although the formula for a pentagon is used, there are six points. This is because the shaping is left rounded rather than taken all the way to a point, which lessens the number of rows and the sharpness of the angles. An extra angle must be knitted to make the beginning and end meet and lie flat.

The octahedron swatch in the next photo uses the same formula and stitch size, but is knitted with only four sections and will make a convex shape when grafted together. When stuffed, it becomes an eight-sided polyhedron in a diamond or lozenge shape.

Also illustrated is a sphere. The principle here is to shape on the selvedge needles only, as in bust darts, with as many non-shaping needles knitting in the center as there are needles shaping at both sides combined. A 16-section spiral shape will be more rounded than a five-section mitered one, but stuffing can do a lot to eliminate angularities.



Right. Octahedron. Made as the star, using the formula for 5 angles, but knitting only 4 angles. Use same number of ndls, same color and SS change as star.
Left. Sphere. Spiral with small eyelets. Ten angles; shaping done over only one-fourth of the needles each selvedge. Stitch size the same over all; color change each repeat.

MITER AND SPIRAL STRIPS

Short row miters or spirals can be used to make zigzag or straight strips from which other shaped strips can be designed.

These strips can be used in many ways. The points on a zigzag can be sewn together to make a circle with a three-dimensional pattern, or a polyhedron. Flat strips can be joined to make afghans, rugs or trims. Making them is also good practice for knitting the whole fabrics of short row angles in the following section.

The principle is that the repeat unit (one miter or spiral angle), as knitted in the previously described methods for single layer polygons, here is reversed on alternate repeats. The carriage begins on one side of the bed for the first repeat, the other side for the second repeat, and continues alternating.

Once you understand how the four basic strips are made (straight and zigzag, miter and spiral), you can design strips of other shapes by inserting panels of straight knitting, changing the alternation of the repeats, or by using two different formulas on alternating repeats. Switching colors or knitting stripes can be very effective. The directions given below are for angles with eyelets. Use wrapping if you prefer.

Zigzag and straight miter strips.

For a zigzag, the repeat begins and ends between two angles. Here you are actually making a series of angles, one from the right, the next from the left. The two halves of the first angle are made with the carriage on one side; the two halves of the next are made with the carriage on the opposite side. The point of each angle will be on the side where the carriage begins.

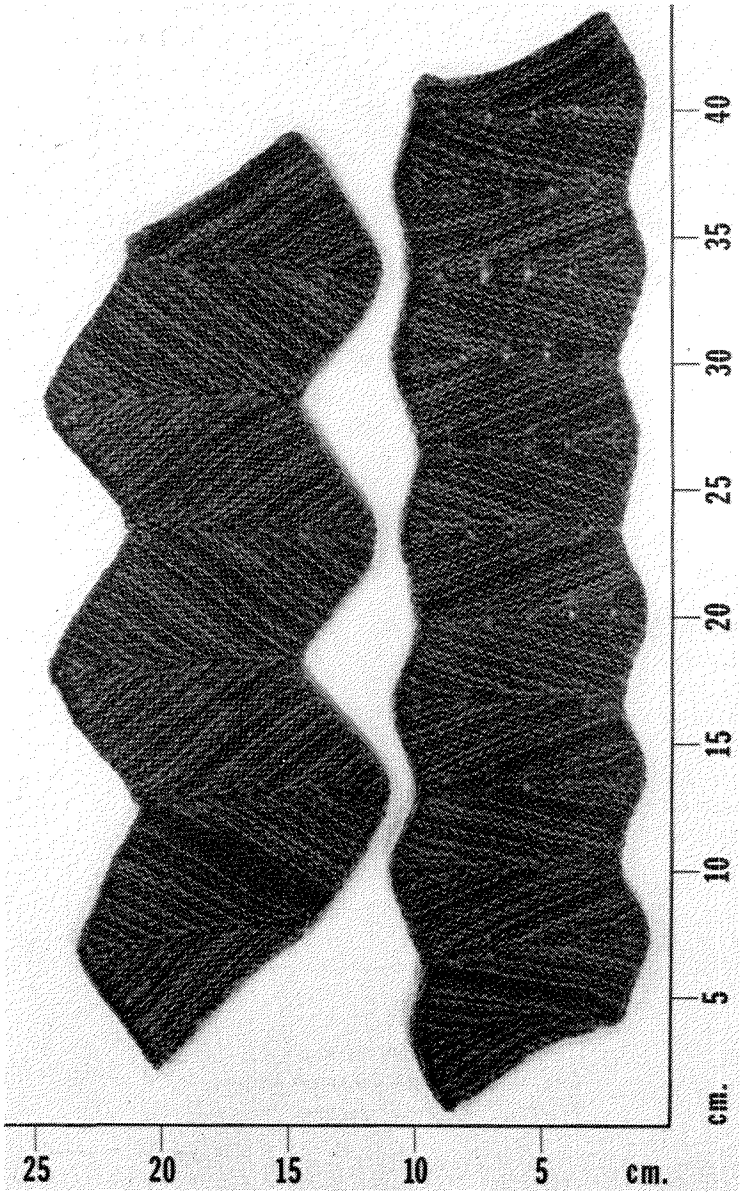
Step 1. Put all ndls in WP. On the side opposite the carriage, start the ndls to HP, RC2 between groups until all ndls are in HP.

Step 2. On the carriage side, put ndls in position to knit, RC2 between groups until all ndls are in WP.

Step 3. Knit one row over all ndls to put the carriage on the other side to begin the next angle.

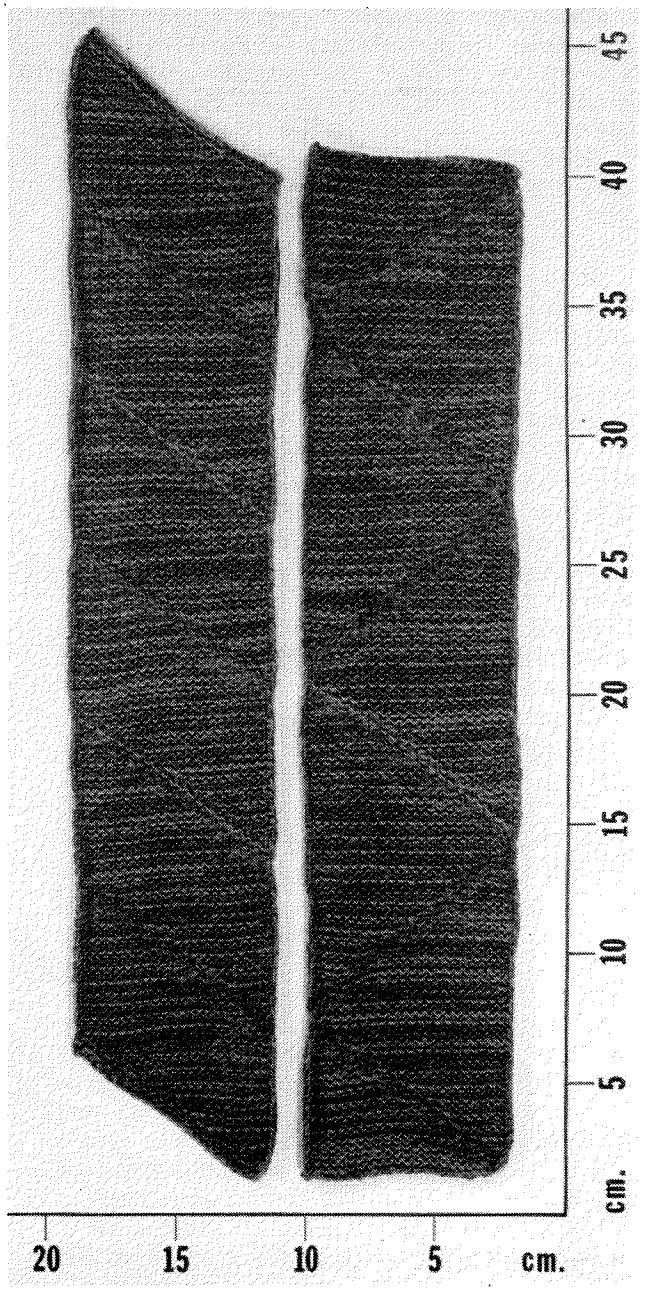
Repeat the three steps.

The amount of zigzag on selvedges will depend on the formula used. For example, a pentagon formula will make deep, widely spaced points, while the decagon formula makes shallow points close together. The strip can start and end at the miter if the first step is omitted at the beginning of the strip, and the second step is omitted at the end.



Zigzag strips with miter angles.
Left. Knitted according to pentagon formula.
Right. Knitted in decagon formula.

The swatches on this and the following two pages are zigzag and straight strips, knitted in marled yarn. Photos show the purl side, so direction of repeats can be seen more clearly.



Straight strips with miter angles. Both swatches were knitted according to the pentagon formula.
Left. Diagonal eyelets. Right. Zigzag eyelets.

For a straight miter strip, the repeat begins and ends at the miter. Unlike the zigzag, the two halves of each angle are now separated. The first half is always made with the carriage beginning on one side; the second half with the carriage beginning on the opposite side.

Step 1. Have carriage at right; all ndls in HP. On the same side as the carriage, put ndls in position to knit, RC2 between groups. On the last group, knit RC1 only, to put the carriage on the other side.

Step 2. Carr now at left; all ndls in WP. On the side opposite the carriage, move ndls to HP, RC2 between groups. After all ndls are in HP, knit RC1 over all to put them back in WP and to put the carriage on the opposite side of the bed.

Repeat both steps.

If the first step is knitted with the carriage at right and the second with the carriage at left, the eyelets will slant from right to left on the purl side. If the first step is knitted with the carriage at left and the second with the carriage at right, the angle of the eyelets will be from left to right.

To make the top and bottom of the strip perpendicular to the selvedges, begin with the second step and end with the first step.

To alternate, or zigzag, the slant of the eyelets, knit the second step with the carriage at left, then the first step with the carriage at right, then reverse. Knit RC2 at the end of the first step (in order to reverse), then knit the second step with carriage at right, and the first step with carriage at left.

Zigzag and straight spiral strips.

Making spirals involves shaping in one direction only, hence shaping zigzag and straight spiral strips is somewhat simpler than miters. To make a straight strip, an angle is knitted once from alternate sides. To make it zigzag, it is knitted twice from alternate sides. The directions given below will produce spiral angles with small eyelets (no wrapping), but they can be made as solid spirals with automatic wrap.

Here's how to make a straight strip with a spiral.

Step 1. Have ndls in WP. On the side opposite the carriage, move groups of ndls to HP, RC2 between.

Step 2. After all ndls are in HP, knit RC1 over all to put them back in WP and to move the carriage to the other side of the bed.

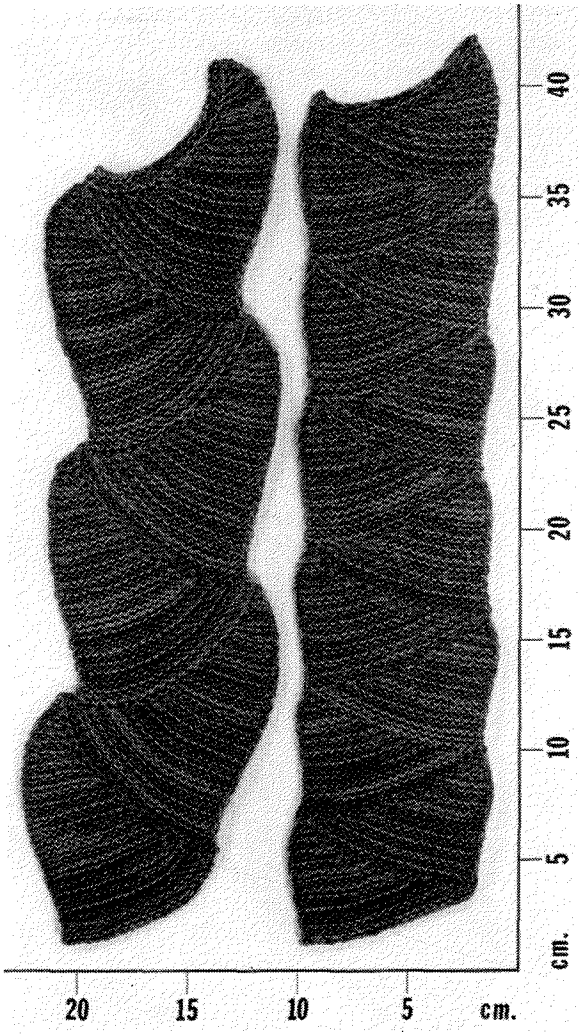
Repeat the two steps with the carriage on the opposite side. The carriage changes sides after each angle.

Zigzag strips with spirals are knitted like the straight strips, except that the carriage changes sides after every *two* angles.

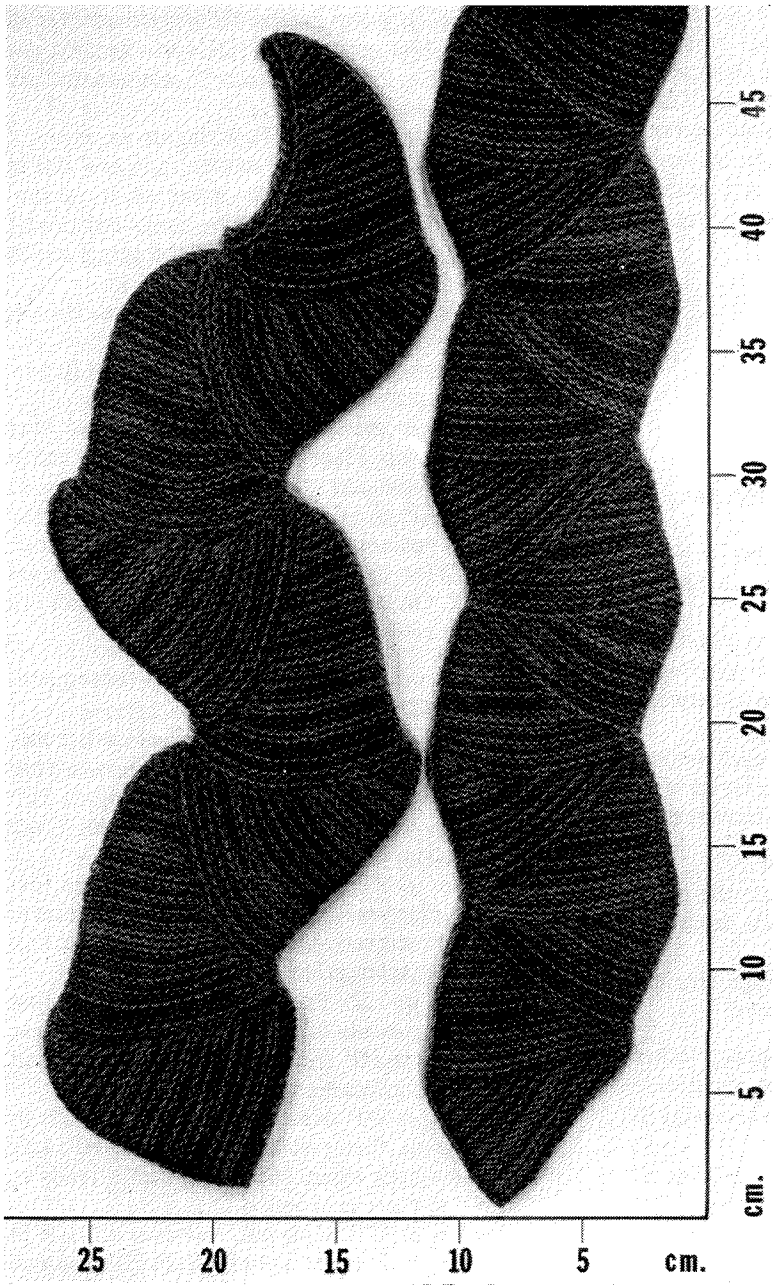
Step 1. Put ndls in WP. On the side opposite the carriage, move groups of ndls to HP, RC2 between.

Step 2. After all the ndls are in HP, knit RC2 over all to put them in WP and to keep the carriage on the same side.

Repeat the first step, then the second step, finishing with RC1 over all ndls to put the carriage on the other side of the bed. Make two angles from the opposite side, and repeat.



Straight strips with spiral angles.
Left. Knitted with pentagon formula.
Right. Knitted with decagon formula.



Zigzag strips with spiral angles.
Left. Knitted with pentagon formula.
Right. Knitted with decagon formula.

BUILDING A FABRIC WITH MITERS AND SPIRALS

Now that you've mastered polygons and strips, you probably have a good idea of how these techniques can be applied to designing whole fabrics composed of repeated miter and spiral sections across the width of the bed. And once you begin to combine short row shapes and fabrics with other types of knitting, you'll discover a new realm of design ideas. You could keep your imagination occupied just with flat or three-dimensional patterning in solid or open short row fabrics, using only the stockinette stitch. When you knit another fabric around and between areas of short row patterning—perhaps jersey jacquard, pin tucks, or lace—you can use the one fabric to draw attention to the other. And the knitting grows more quickly!

The fabrics in this section are simply elaborations upon those already discussed. These, too, involve knitting one miter or spiral angle after another, but now across the width of the bed. Each one is knitted in turn, while all the others wait with needles in holding position. Both the single and double angles can be used, and there are limitless possibilities for combining them.

Designing short row patterned fabrics.

The following approach to designing short row fabrics, with a repeating angle across the width, is by no means the only one. You will undoubtedly find ways to modify it, or you may develop an entirely different scheme based on your own machine and your knowledge of stitches and yarns. The knitting suggestions given below are for stockinette fabric, in one or two colors.

First, divide the needles into groups with an even number of needles in each. Each group will, in turn, knit one repeat of the pattern (one miter or spiral angle). The groups should have enough needles so that they can be divided in half and still have enough needles to do some shaping. Mark these divisions on the needle bed for easy reference.

Start the first angle on the first group of needles next to the carriage. These needles can be either in WP or HP, but all the remaining groups across the bed are in HP. When the first group is finished with the angle, put those needles in HP and start the pattern again on the next group. Continue this way across the bed.

The formula used in all the swatches is one needle per group, RC2. This makes it easy to control both eyelet and automatic wrap kind of shaping.

Here are some suggestions for the first pattern row of angles: Try one pattern repeat per group across the bed. Or overlap repeats -- after the first group, use half the needles of the first group and half of the second. Or skip every other group by knitting one or several rows plain in that space.

For the second pattern row of shapes, try one of these suggestions. Knit one or several rows across all needles before starting the second row of shapes. Start the same pattern again from the same side of the bed as the first row, or from the side opposite. Make repeats of the pattern on the same needle groups as the first row, or make half a repeat at each end so that the repeats will alternate with those of the first row.

Add a second color on alternating pattern rows, or knit the pattern in color 1 with some rows of plain knitting across all needles in color 2 between pattern rows (which can be further patterned with garter stitch or lace, for example).

Here are some other methods of pattern variation: Divide the needle bed into groups which have an unequal number of needles. Or you might combine two or more formulas from the polygon chart. Try alternating different formulas in every other group, or use the same formula with RC4 to make a three-dimensional fabric. Or add rows of plain knitting to increase the depth of the repeat. This technique works particularly well on mesh-type short row fabrics to make a large mesh.

The swatches illustrate a variety of fabrics based on the suggestions just given. Each of them is explained in accordance with the key below. Read the letter codes in the order they are given with each swatch and you will have a complete set of instructions for knitting each fabric.

INSTRUCTION KEY

The following are instructions for knitting swatches of fabrics built of spiral angles and miter angles. These instructions are given in "code" in the photo captions on the following pages. Match the code, in the order given, to the letters and numbers below, and you will have a complete set of instructions for each fabric. All swatches are knitted 72 needles wide.

A. Divide needles into groups:
   1. of 24 needles
   2. of 24 needles subdivided to 12
   3. of 12 needles subdivided to 6
   4. of 12 needles

B. Repeats in each pattern row:
   1. Pattern repeats neither overlap nor alternate, but are the same each row.
   2. Pattern repeats overlap across the row.
   3. Pattern repeats alternate on successive pattern rows.
   4. There is half a repeat at the beginning and end of the second pattern row. Use half the number of needles and double the number of rows between needle movements.
   5. There is half a repeat at the end of each pattern row. Use half the number of needles and double the number of rows between needle movements.

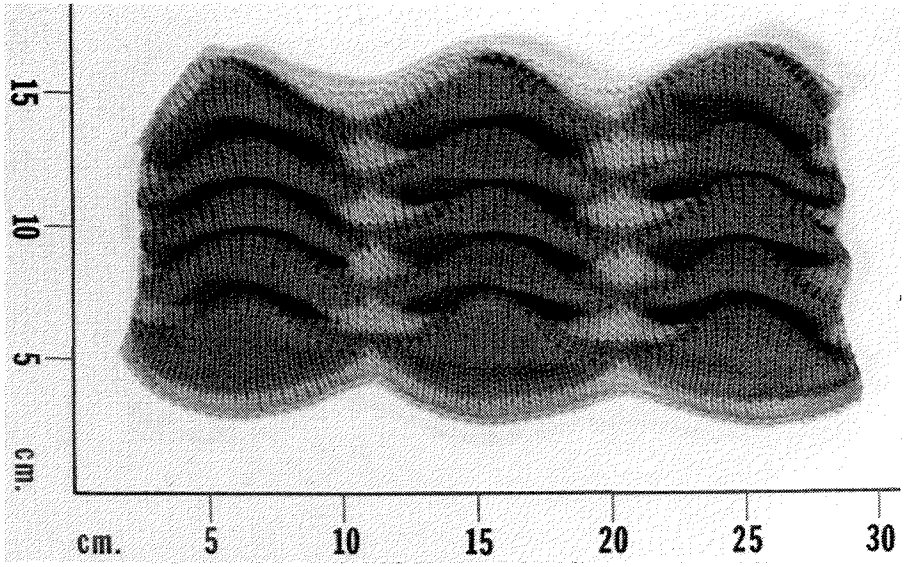
C. Knitting direction of each pattern row:
   1. All pattern rows are knitted from the same direction; the carriage always starts from the same selvedge.
   2. Knitting direction alternates; carriage changes starting side on alternate pattern rows.

D. Needle movements with each repeat group (other groups are in HP). The formula: move one needle in or out of HP, knit two rows. It is not necessary to wrap the adjacent needle.
   1. Needles in group in WP: knit one row over all ndls in first group. *On side opposite carr, put first end ndl in HP; knit one row. On side opposite carr, put one end ndl in HP; knit one row.* Repeat until all ndls are in HP. Yarn will be in center of group.
   2. Needles in group in WP. Knit two rows over all ndls in first group. *On side opposite carr, put first ndl in HP; knit 2 rows.* Continue until all ndls are in HP.
   3. Needles in group in HP, with yarn in center of group. *On same side as carr, put first ndl in center of group in position to knit; knit one row. Put adjacent center ndl in position to knit; knit 1 row.* Repeat until all ndls in the group are in WP.
   4. Needles in group in HP. *On same side as carr, put first ndl in position to knit; knit 2 rows. Put next ndl in position to knit; knit 2 rows.* Repeat until all ndls in group are in WP.
   5. Needles in group in WP. Knit one row over whole group. Place in HP the half of the group opposite the carr. *Place first WP ndl next to carr in HP, and first HP ndl on side opposite the carr in position to knit; knit 2 rows.* Continue until WP ndls all are in HP, and all HP ndls are in WP. On last sequence, knit only one row (12 knitted rows total).

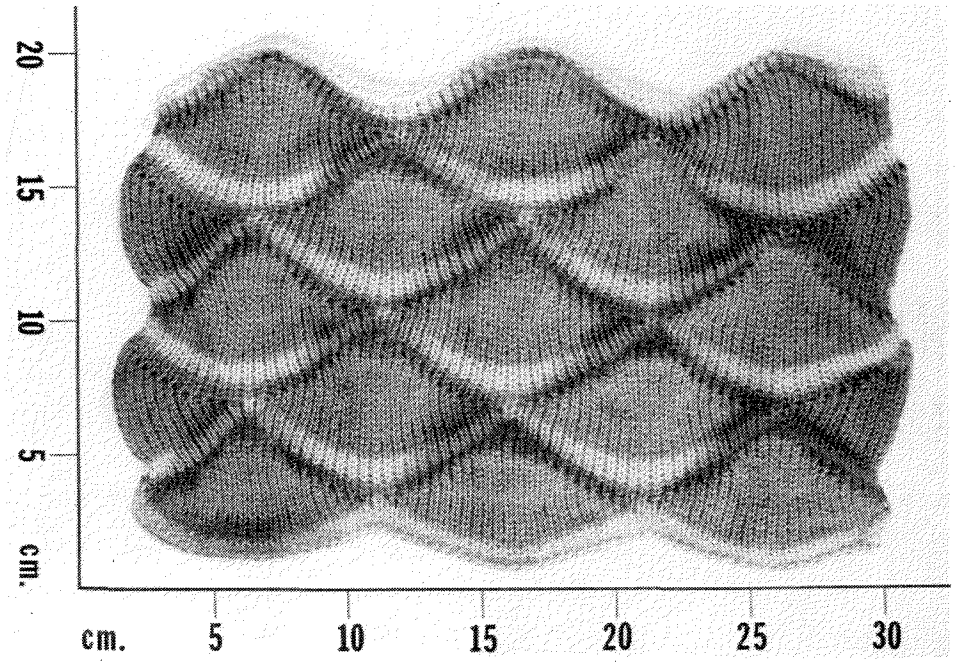
E. Moving from first to second, and subsequent, needle groups:
   1. Needles in HP. Put second half of first group, plus all ndls of next group, in position to knit; knit 1 row. Put all ndls of first group in HP. (Second group is ready to knit * to * per instruction D.)
   2. Needles in HP. Put second half of ndls in first group, plus first half of next group, in position to knit; knit one row. (Second group is ready to knit * to * per instruction D.)
   3. Needles in HP. Put first half of ndls in first group in position to knit; knit one row. Put these ndls back to HP. (Second group is ready to knit * to * per instruction D.)
   4. Needles in WP. Knit one row over all ndls in first group, then put all these ndls to HP; knit one row back again. (Second group is ready to knit * to * per instruction D.)
   5. Needles in WP. Knit one row over all ndls in first group. Put first half of ndls in HP; knit one row. Put second half to HP. (Second group is ready to knit * to * per instruction D.)

6. Needles in WP. Put ndls in second group in position to knit. Knit one row over all first group ndls, plus those in second group. Put ndls of first group to HP. (Second group is ready to knit * to * per instruction D.)
7. Needles in WP. Put ndls in second group in position to knit. Knit one row over all first group ndls plus those in second group. Put ndls of first group to HP. Knit one row back again. Second group is ready to knit * to * per instruction D.)
8. Needles in WP. Put ndls in first half of second group in position to knit. Knit one row over all ndls in first group plus those in first half of second group. Put first half of ndls of first group to HP. (Second group is ready to knit * to * per instruction D.)
9. Put all ndls in this group in position to knit, plus all those of the next group; knit one row. Put all ndls of first group in HP, plus first half of second group. (Second group is ready to knit * to * per instruction D.)

F. Moving from the first pattern row to the second, and subsequent, pattern rows:
   1. Second patt row begins on side opposite first patt row. Carriage is now in position to start.
   2. At end of patt row, knit one row over all ndls to bring yarn back to starting side.
   3. Free pass across bed to pick up col 2 at opposite end of bed and to start second patt row from that side.
   4. Knit 4 rows across all needles with color 2, starting from either direction.
   5. Cut yarn, and thread with color 2. Carriage is now ready to start next row. Optional: knit one row over all sts to bring yarn back to starting side so it won't have to be cut. Then, free pass back to this side to start next row with color 2.

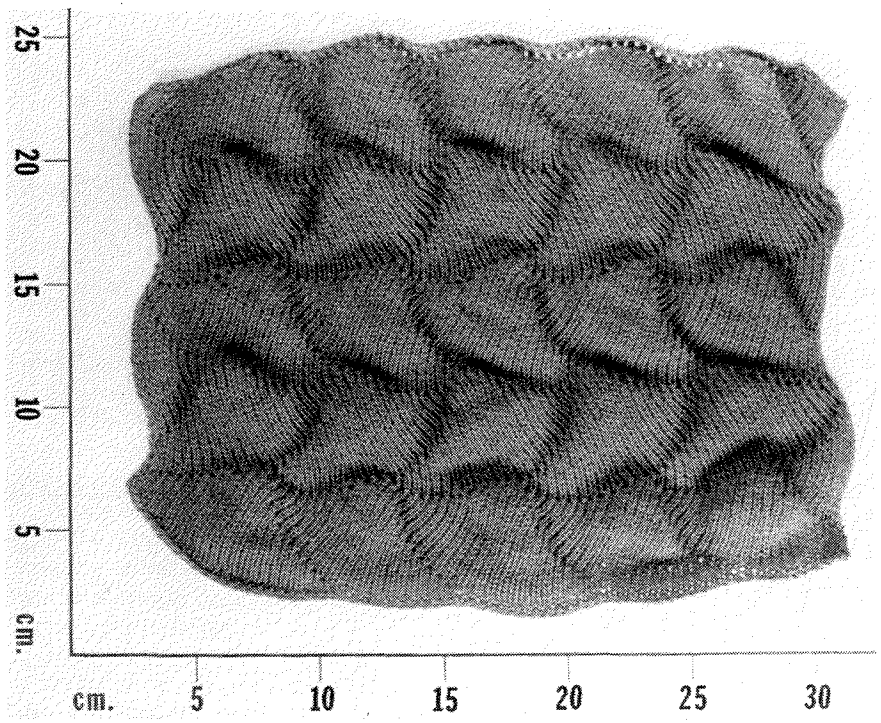


Knit according to the instruction key:
A1, B1, C1, D1, E1, F2, F4

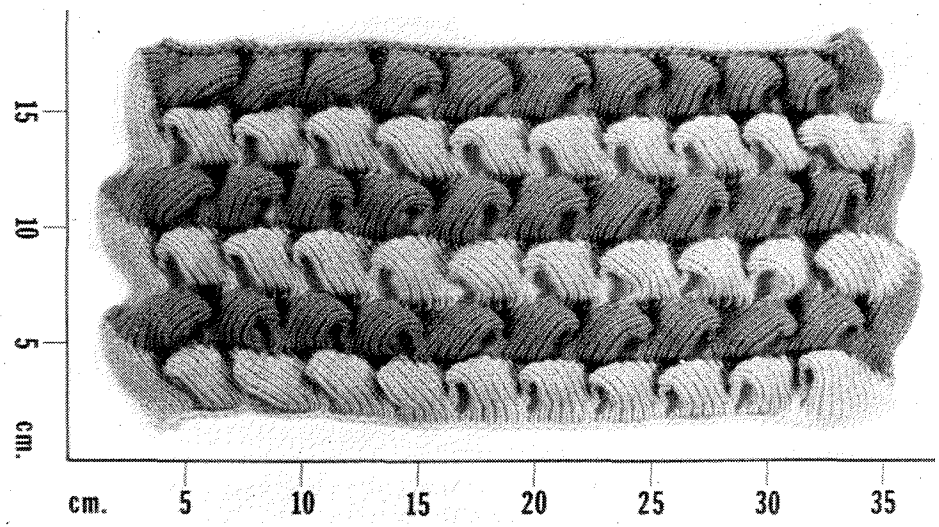


Knit according to the instruction key:
A2, B3, B4, C1, D1, E1, F2, F4

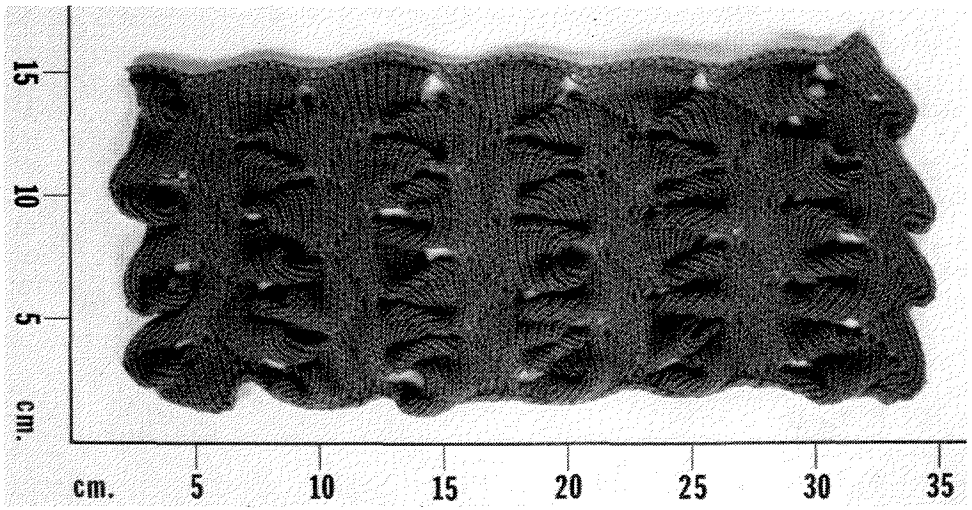
Fabrics shown on this page are based on spiral angles.



Knit according to the instruction key:
A2, B2, B5, C2, D1, E2, F1

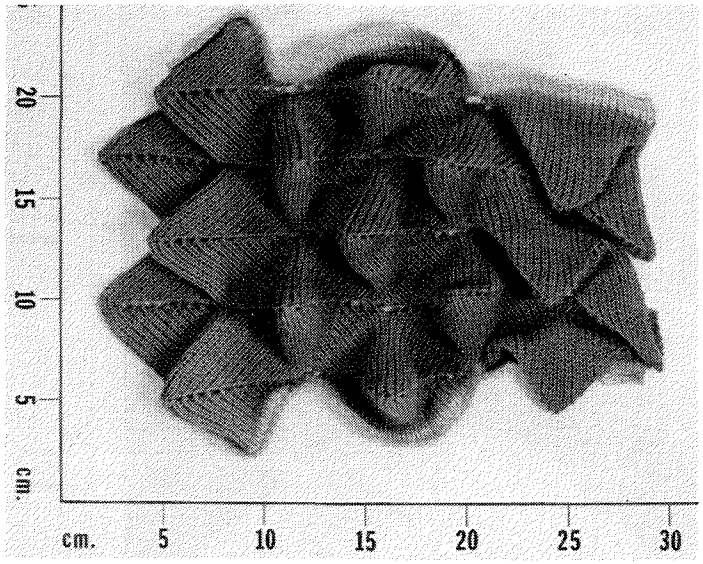


Knit according to the instruction key:
A3, B2, C2, D4, E5, F2, F3

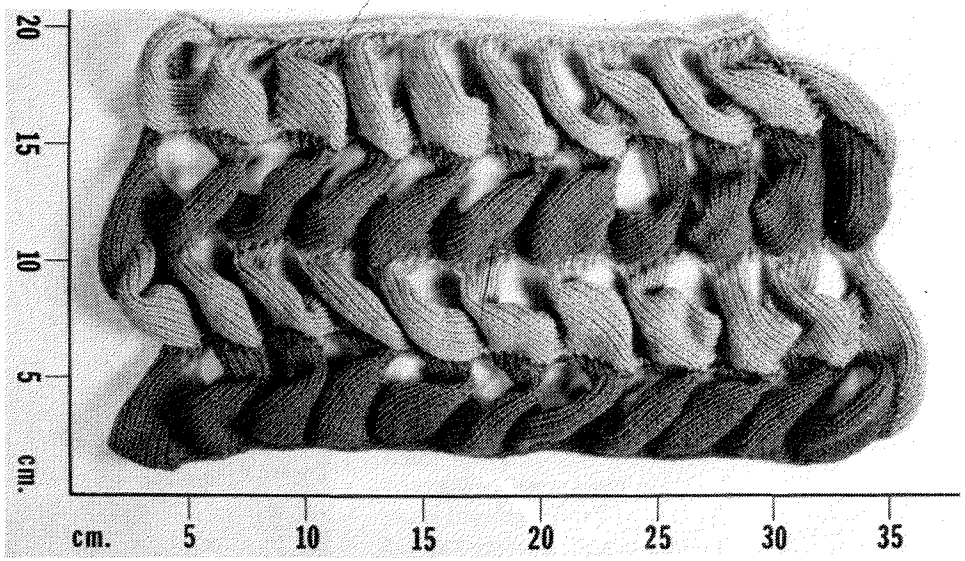


Knit according to the instruction key:
A3, B3, B4, C2, D4, E4, F1

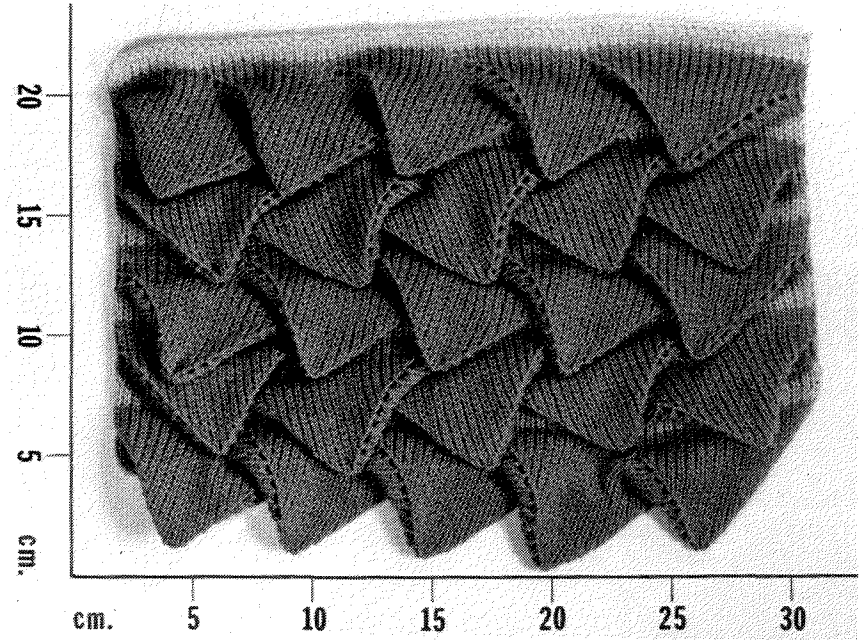
Fabrics shown on this page are based on spiral angles.



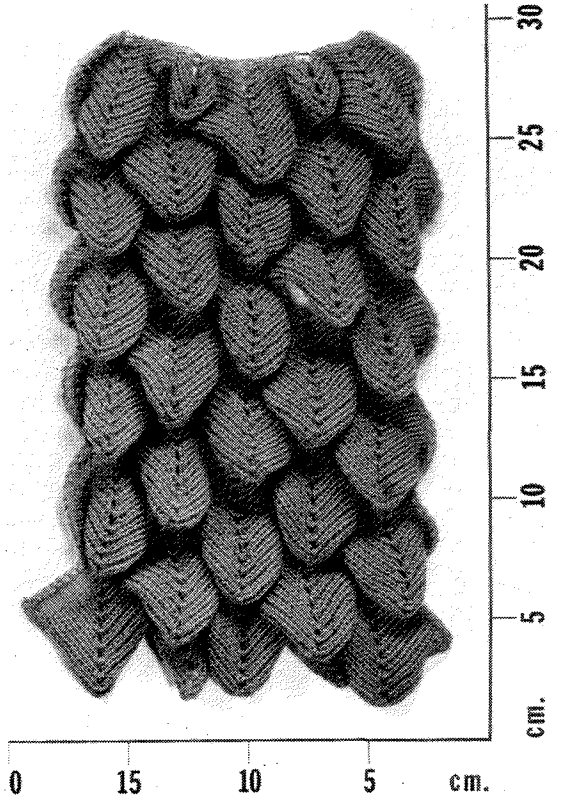
Knit according to the instruction key:
A2, B3, B4, C2, D1, D3, E6, F1



Knit according to the instruction key:
A3, B2, C2, D4, D2, E3, F2, F3



Knit according to the instruction key:
A2, B2, C2, D1, D3, E8, F1, F4



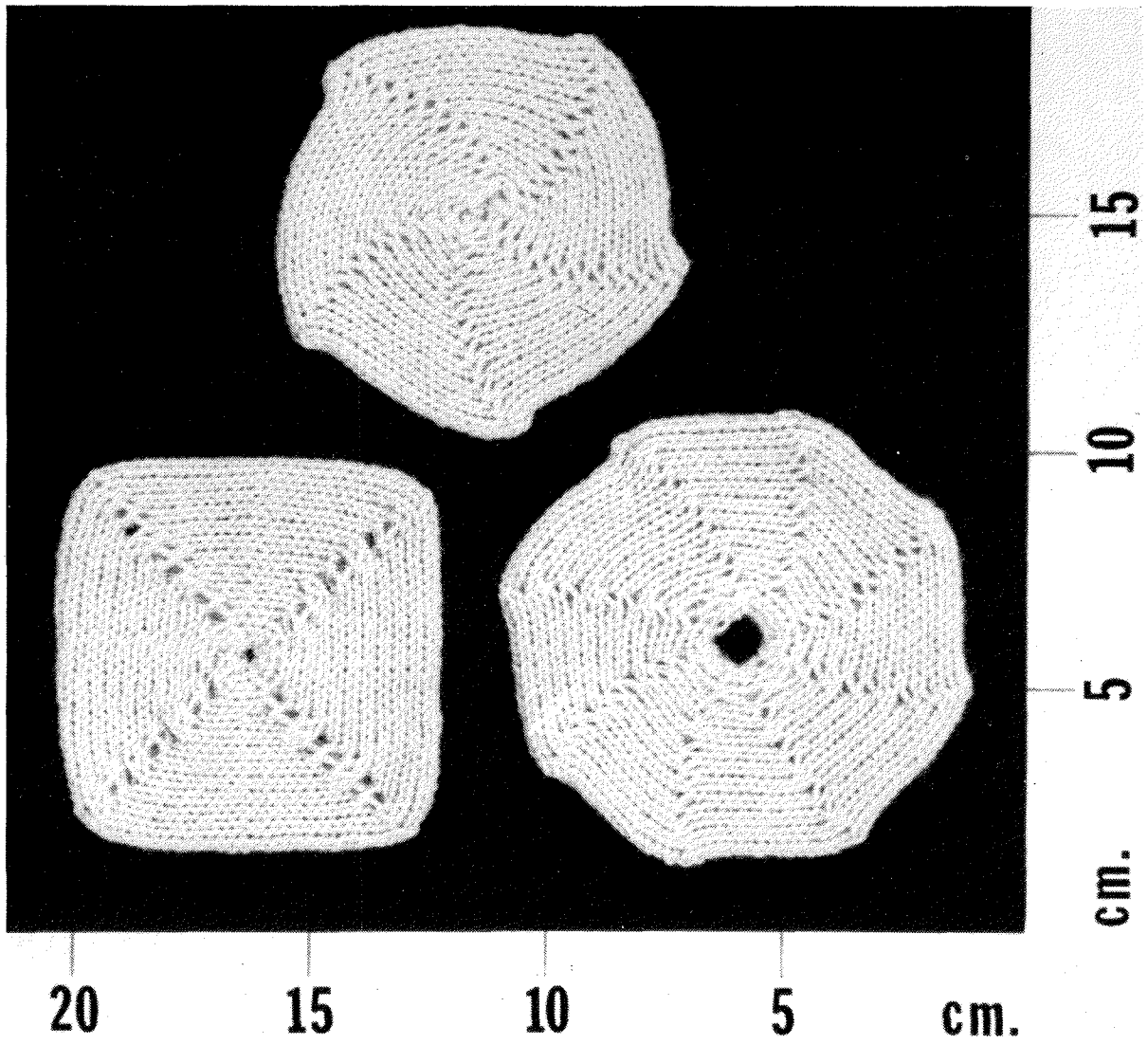
Knit according to the instruction key:
A3, B3, B4, C1, D2, D4, E7, F2

Fabrics shown on this page are based on miter angles.

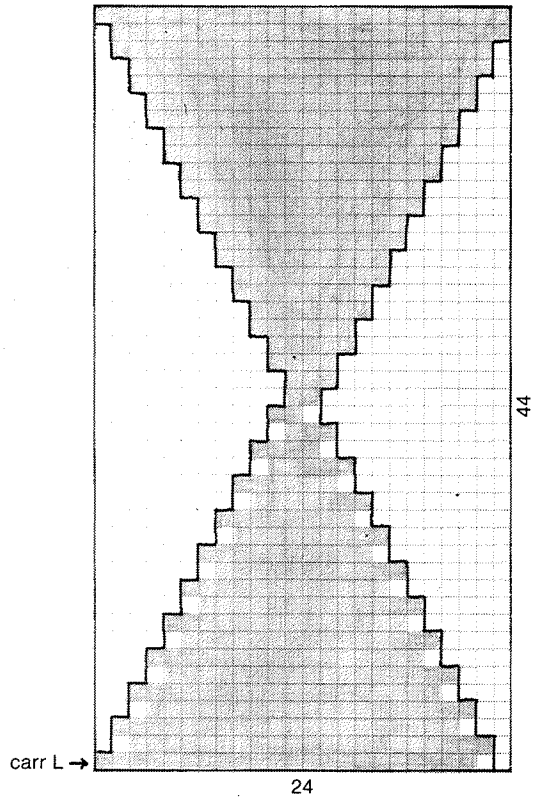
USING A PUNCHCARD TO KNIT MITER AND SPIRAL ANGLES

Short rows, like intarsia, can be knitted with a punchcard. Cams are set for slip in both directions, and holes are punched for those areas of each row which are to knit. The advantage to knitting short rows with a punchcard is speed. Polygons and strips can be knitted more quickly, and so can all-over fabrics patterned with short rows. These can be tedious and discouraging when knitted without a punchcard. The disadvantage with punchcards is that automatic wrap isn't possible. However, on Superba, Brother/Knitking and Singer/Studio, the card can rotate ER, and decreasing angles can be punched in such a way that in a mitered angle, small, neat eyelets are formed. In a spiral angle, the angle is marked by an enlarged stitch rather than with an eyelet. On Passap, where the card can rotate only EOR (or every 4 rows), the card must be punched differently, and the angles will be marked by regular eyelets unless wrapping is done manually. Additionally, on doubled spiral angles there will be a long float between the end of one angle and the start of the next.

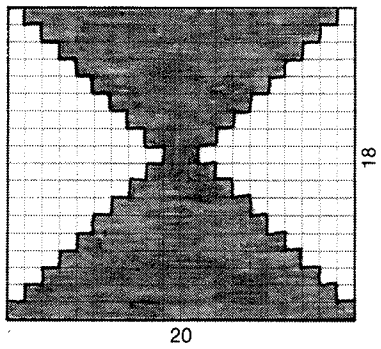
Illustrated are examples of punchcards used to knit three-dimensional polygons in two different formulas. In the first, one needle is moved, RC2. In the second, one or two needles are moved, RC2. Both formulas are for both miter and spiral shapes. Each diagram is one complete repeat. Punch only the dark squares; the black outline is just to show how the formula is drawn on the card. You can design your own cards from these, using other formulas. For a flat polygon, use either the right or left half of the chart. Add extra rows of plain knitting and reverse the right and left halves for strips and all-over fabrics. You can make the shape as wide as the card and in any chosen formula. Short row pattern cards can be designed to make berets and slippers, which would require wide punchcard widths such as the 40-stitch width for Passap and the 60-stitch width for Superba. They can also be designed for ruffles and baby booties, which require narrow width punchcards.



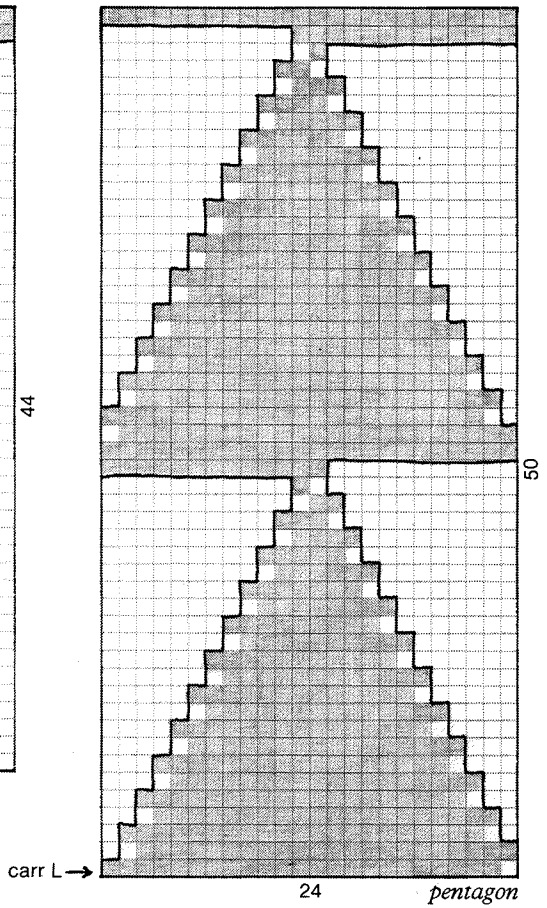
Miters and spirals made with a punchcard. Short row Patterns 2, 3, and 4 are shown knitted as doubled polygons (knitted on a Japanese machine).
Top. Pattern 2, spiral pentagon.
Bottom left. Pattern 3, miter square.
Bottom right. Pattern 4, spiral octagon.



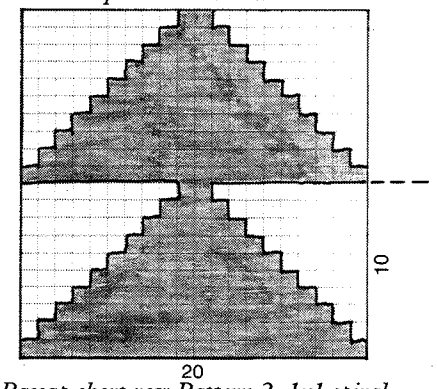
Short row Pattern 1 for Japanese machines and Superba, 1x1 miter.



Short row Pattern 1 for Passap, 1x1 miter.

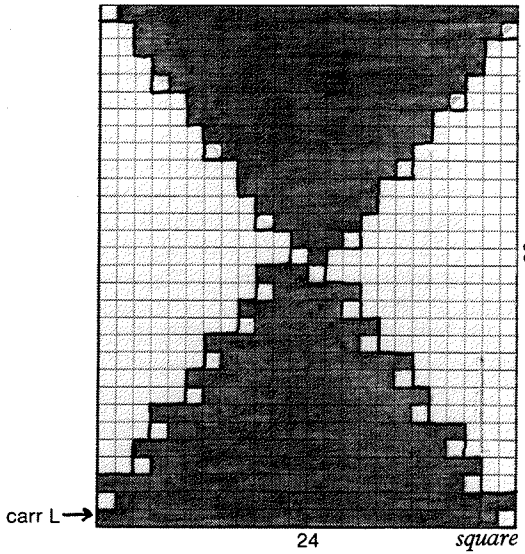


Short row Pattern 2, 1x1 spiral. Two repeats are shown.

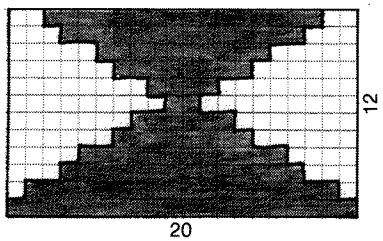


Passap short row Pattern 2, 1x1 spiral. Two repeats are shown.

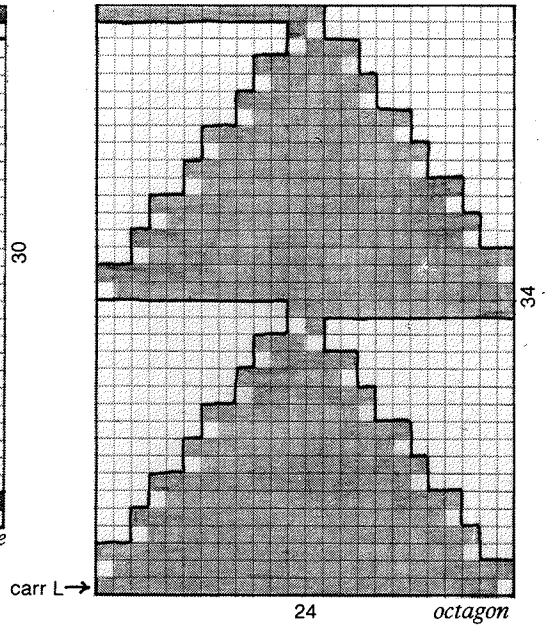
Punch these cards like jacquard Type A-1 punchcards. Punch the dark squares only.
On Brother/Knitking and Singer/Studio: cast on with waste yarn, end with carr R. With main yarn, knit preparation row (one row R to L). Set cams for slip, start card with ER rotation. To start with the carr at R, turn the card over or punch the design reversed.
On Superba: Cast on with waste yarn; end with carr L. With main yarn, knit one row L to R. Set cam for slip, start card with ER rotation with carr R. On Passap: Cast on with waste yarn, end with carr R. Set cams BXo, Deco 2. Start knitting with main yarn. The short row angle can be up to 40 sts.



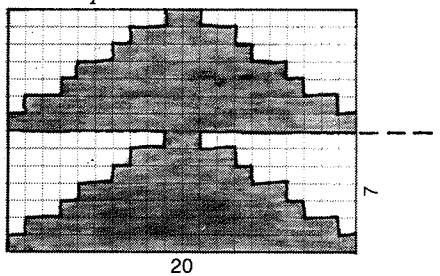
Short row Pattern 3, 2x1 miter.



Passap short row Pattern 3, 2x1 miter.



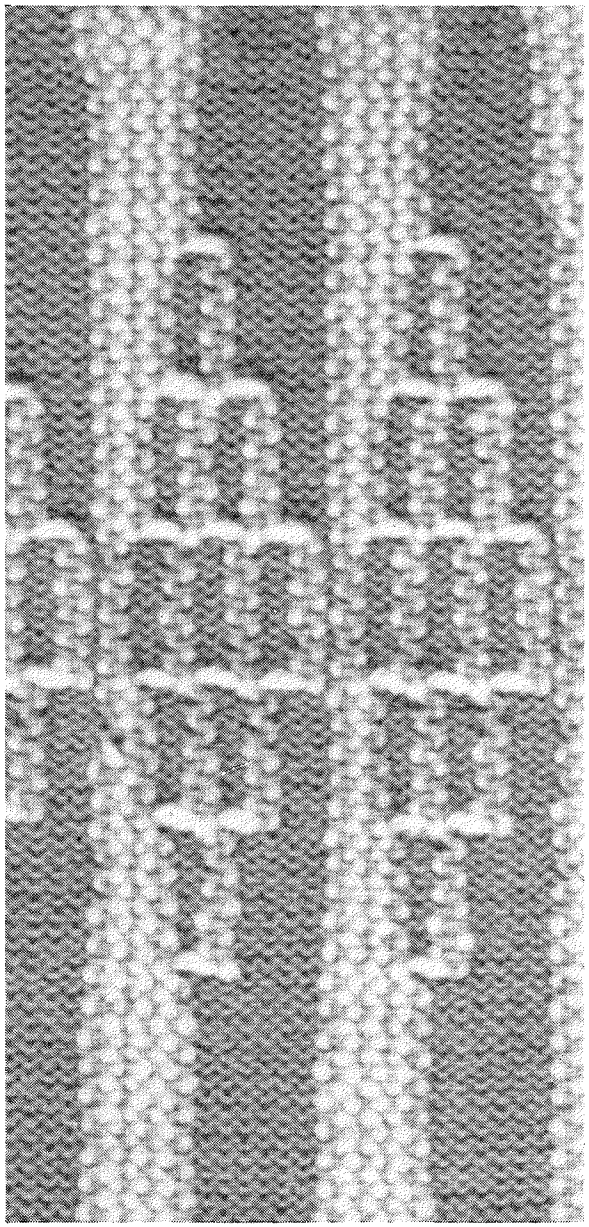
Short row Pattern 4, 2x1 spiral.
Two repeats are shown.



Passap short row Pattern 4, 2x1 spiral.
Two repeats are shown.

Punch these cards like jacquard Type A-1 punchcards. Punch the dark squares only.
On Brother/Knitking and Singer/Studio: cast on with waste yarn, end with carr R. With main yarn, knit preparation row (one row R to L). Set cams for slip, start card with ER rotation. To start with the carr at R, turn the card over or punch the design reversed.
On Superba: Cast on with waste yarn; end with carr L. With main yarn, knit one row L to R. Set cam for slip, start card with ER rotation with carr R. On Passap: Cast on with waste yarn, end with carr R. Set cams BXo, Deco 2. Start knitting with main yarn. The short row angle can be up to 40 sts.

CHAPTER 11 Inlay Fabrics Weaving, Weft Knitting and Vertical Weaving



WEAVING

Weaving is a single bed technique using only the back bed of all machines. It is known to some as *thread knitting, knit-weave, inlay* and *lay in.* In weaving, an extra yarn is laid or woven in amid the stitches on the reverse or purl side of a fabric without ever making stitches itself. Instead, the weaving yarn moves above and below the stockinette stitches being knitted with another yarn. The weaving yarn does not move back and forth between the knit and purl sides of the fabric; it shows just on the purl side above and below the purl stitches. It may, however, show on the knit side as grin-through, between the knit stitches.

Weaving has many of the characteristics of a weft knit fabric; it has comparatively little stretch across the width and it is firm and stable. The main knitting is commonly done with a fine yarn which acts simply as a foundation for the woven pattern, which is done with a second yarn, generally of a much heavier weight. The weaving yarn, however, can be as fine as sewing thread, textured like boucle, or even an elastic thread. Patterns such as lace, eyelet and tuck designs can be effectively incorporated into the stockinette to alternate with the weaving. The Brother/Knitking and Singer/Studio stitch pattern books have many such designs.

CONSTRUCTING THE FABRIC

The backing fabric for weaving is generally stockinette, but the weaving itself must be done in some sort of pattern. Needle selection can be made either automatically, using a punchcard on Superba, Brother/Knitking and Singer/Studio; or manually, with a pattern ruler or Jac 40, on all machines. The knitting and weaving yarns are threaded through separate tension arms, and the weaving brushes on the carriages set in position; they hold the weaving yarn firmly against the sinker posts so it doesn't caught in the needle hooks. The black strippers are used on Passap. The knitting yarn is threaded through the carriage as usual, with a stitch size slightly larger than normal for stockinette. The weaving yarn is fed manually, either from special slots on either side of the carriage or by laying it across selected needles before the carriage knits. The machine manuals give very clear instructions for automatic weaving with a punchcard on each machine, except that for Passap, for which instructions are given in the Tapestry Weaving section of this chapter.

The three weaving methods outlined below all result in the same fabric construction.

MANUAL WEAVING

Move all working needles to patterning or holding position. Put weaving brushes in WP. Weave the weaving yarn over and under the needles, pushing it close to the sinkers. With cams set for stockinette, move the carriage with the knitting yarn across, thus knitting all needles back to normal working position. Where the weaving yarn shifts from above the needles to below the needles it will be caught by one side of the knitted stitch. Otherwise the weaving yarn will show as floats, either in an upper position, where it was placed above the needles; or lower position, where it was placed below the needles. Also contributing to the design are the sinker loops of the knitting yarn, which will be quite apparent on the purl side where the weaving yarn shifts to above or below the needles.

AUTOMATIC WEAVING WITH A PUNCHCARD

On machines with weaving brushes and special holders on the carriage for the weaving yarn, the up and down movement of the weaving yarn can be governed by a punchcard. Selection of needles to patterning position, directed by punched holes, will cause the weaving yarn to pass above the needles; unselected needles, directed by unpunched spaces, will cause the weaving yarn to pass below the needles. Needle selection, the laying in of the weaving yarn, and the actual knitting of the stitches all take place simultaneously with each pass of the carriage. These steps are described in detail in the machine instruction manuals.

COMBINING MANUAL AND AUTOMATIC WEAVING

If a punchcard is used for needle selection, and the carriage set so selected needles will move to patterning

position before the row is knitted, the weaving yarn can then be manually laid across the latches of the selected needles, and the carriage with the knitting yarn moved across to knit the needles back. Doing this allows you to make changes in the pattern at will, to add beads or other ornaments, to wrap needles for bobbles, or to use more than one weaving yarn in a row for tapestry (bobbin) weaving. The following are some manual variations of automatic weaving.

Most instruction manuals suggest avoiding long floats of weaving yarn, which can cause unsightly sag and snag, by using punchcards with no more than four or five consecutive holes either punched or unpunched in a horizontal row. You can add beautiful patterning with long floats, however, by tucking the floats up manually every few rows (pull them together in a group and hang them on a needle), or by latching them up and hanging the last one on a needle, much as you would handle long floats in jersey jacquard. Floats can also be cut into fringes, spaced either throughout the pattern or in panels. Following are some suggestions for making long floats an integral part of the design.

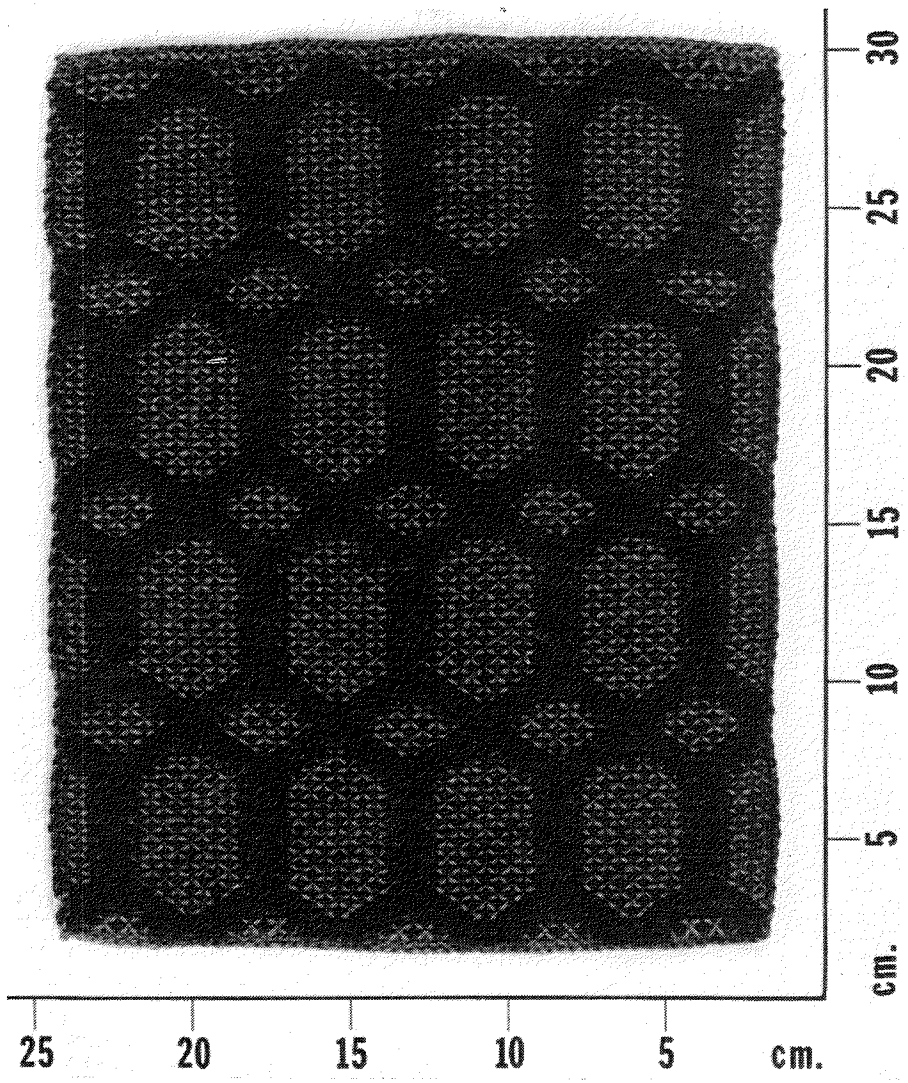
Use a punchcard with a number of consecutive spaces punched or unpunched for three or four vertical rows.

Use isolation cams to separate panels of weaving. Floats will then form between panels.

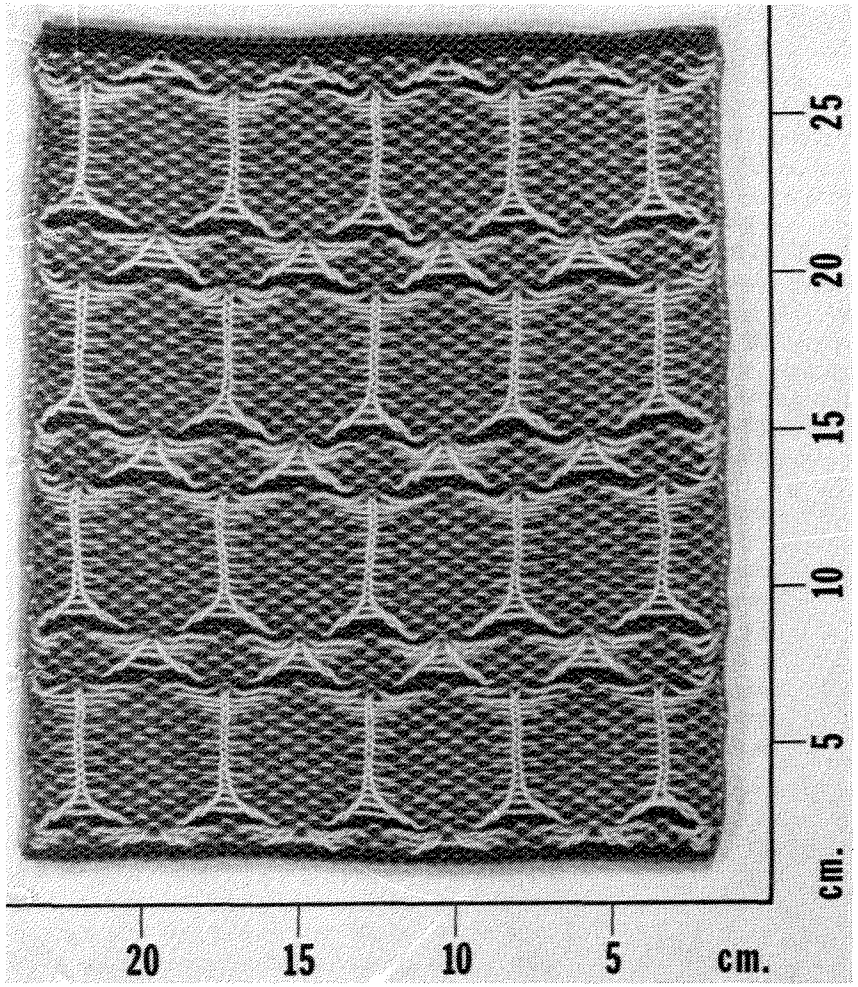
When laying in the weaving yarn manually across selected needles, pass the weaving yarn *under* certain groups of selected needles for several rows to make groups of long floats.

For additional decoration, long loops of yarn can be pulled down between the needles and later knotted or strung with beads. Small bobbles can be made by wrapping selected groups of two or three needles once or twice with the weaving yarn. Push these needles all the way out to holding position so the bobbles won't fall off as the needles are knitted back.

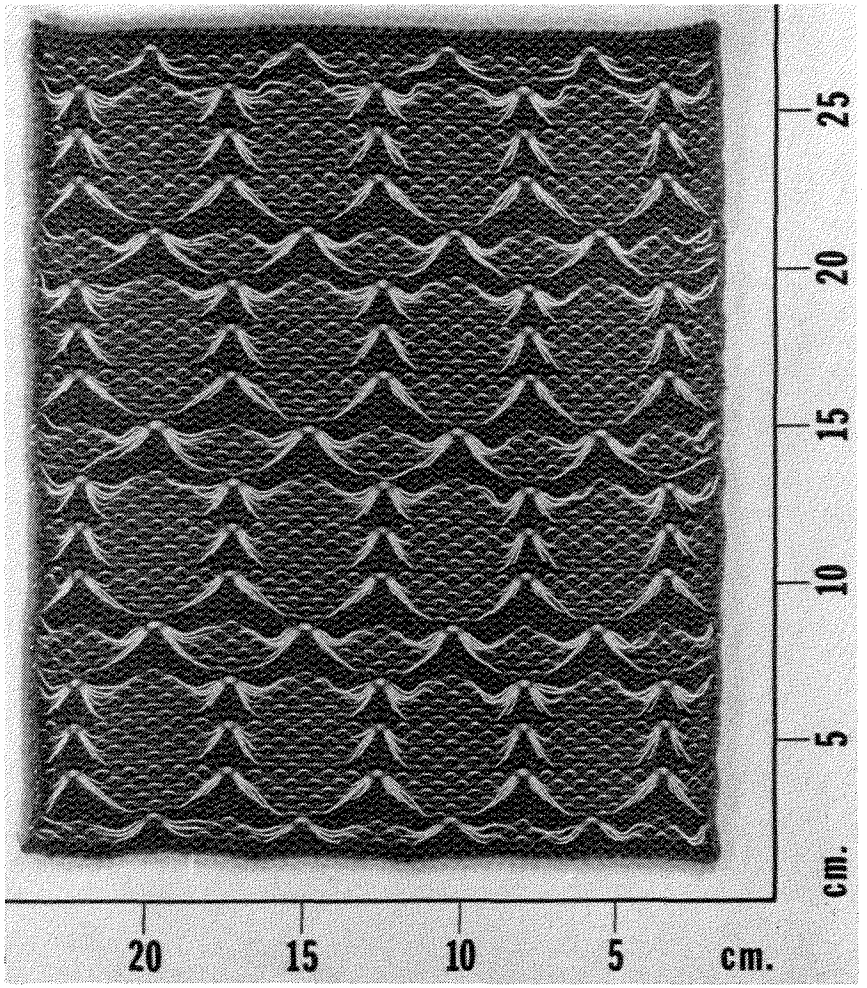
Weaving can be done with very bulky yarn, knitted cords, ribbons, upholstery braids or other materials too thick and heavy to be laid on the needles. With a transfer tool, lift one or more stitches off their needles, pass the cord behind them, then replace the stitches. The cord will then "float" on the knit side of the work. To avoid crowding the cord, knit two or three rows of plain stockinette between such lay-ins.



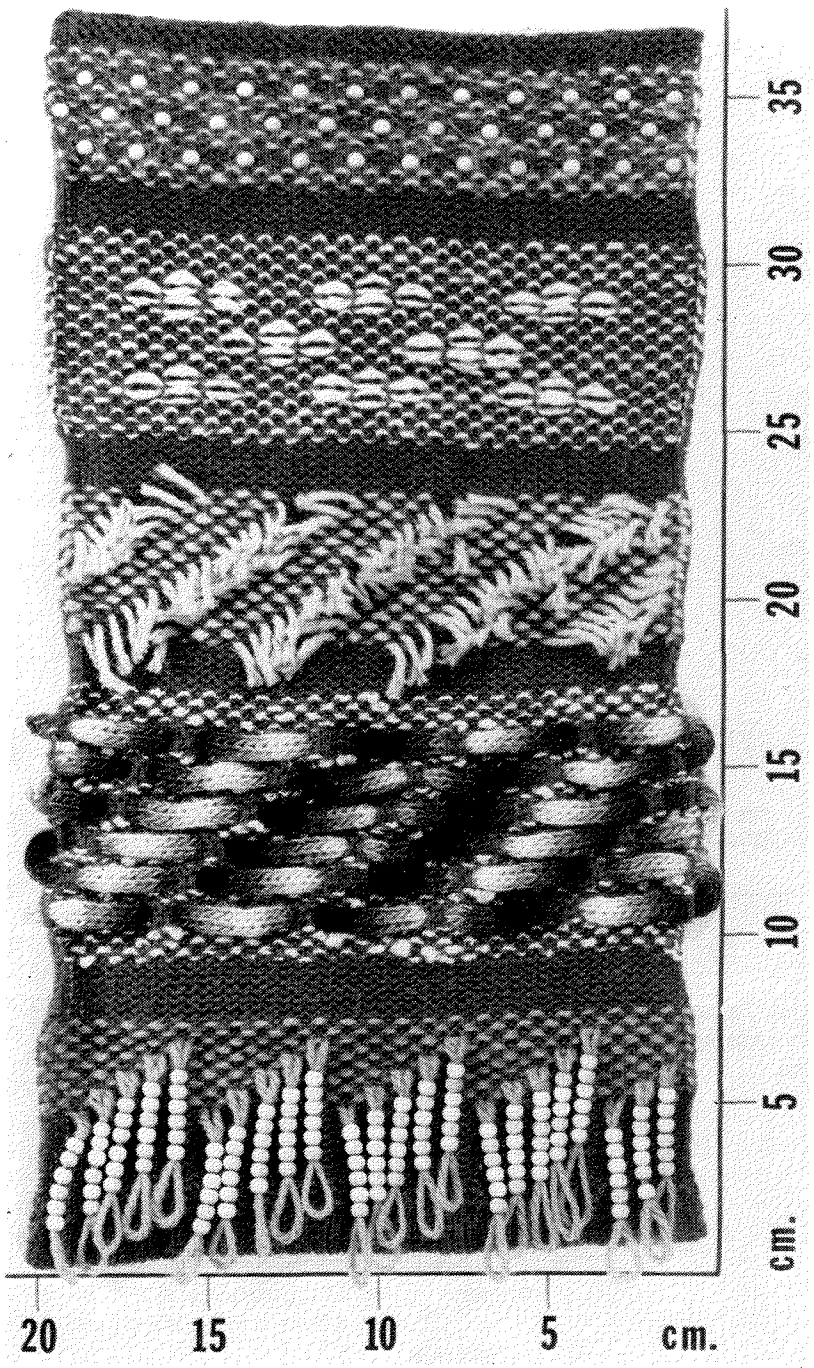
Weaving. Jacquard Pattern 1; automatic lay-in with weaving feeders. Medium yarn for knitting; heavy yarn for weaving.



Weaving. Jacquard Pattern 1; automatic lay-in. Medium yarn for both knitting and weaving. Weaving floats latched up as each section of repeat is completed.



Weaving. Jacquard Pattern 1; automatic lay-in. Medium yarn for knitting; fine yarn for weaving. Weaving floats are gathered together and hung on a needle every few rows.



Tapestry weaving; sampler illustrating decorative variations. All use 1x1 alternating needle selection for ground pattern. Instructions, bottom to top:

1. Select ndls to patt pos and lay yarn across, pulling down a loop of yarn between ndls at intervals and hooking around a ndl on the opposite bed (to standardize their length). Knit one or more patt rows between each loop row. After knitting, string with beads.

2. Knitted cord of space-dyed yarn laid into the knitting by removing 2 sts from their ndls, laying the cord behind the 2 sts, then replacing the sts. Repeat at intervals across the row. Knit rows just prior and just after the lay-in should be without patterning.

3. Long floats of 7 ndls each at intervals on successive pattern rows; floats are then cut to make fringe after knitting.

4. Bobbles, each 3 ndls wide. Select all pattern ndls across row to patt pos and lay the yarn across the ndls. Where each bobble is to occur, wrap yarn 3 times around the first and last bobble ndls. If there is a ndl between the first and last bobble ndls which is not in patt pos, bring it out to patt pos. After yarn is laid across the entire row, bring the bobble ndls out to HP to prevent the yarn from falling off as the row is knitted.

5. Beads added during knitting. This is not a weaving technique but looks nice with weaving or on virtually any stockinette fabric. The beads are visible from both knit side and purl side of fabric. Select beads which are of a suitable size for your yarn and stitch size. The hole must be large enough for a small crochet hook to fit through. To place each bead into the knitting, unknit the current st, pick up a bead with a small crochet hook, lift the present stitch off the ndl with the crochet hook, slide the bead onto the stitch, replace the stitch on the needle, then reknit the unknitted stitch.

TAPESTRY OR BOBBIN WEAVING

Tapestry weaving allows tremendous freedom of design. You can work freeform with diagonal, vertical or horizontal shapes, or work from a preplanned graph or chart.

A punchcard is used to select needles to weave the yarn in a textured pattern, exactly as in one-color weaving. However, the main design doesn't come from the texture pattern, but rather from the diversely colored shapes incorporated into the weaving. This means that more than one color of yarn is woven into a row, which in turn means the needles selected by the punchcard must move out to patterning position and stay there so that the yarn can be laid across them—a combination of manual and automatic weaving. The knitting yarn is threaded through the tension arm and carriage as usual. The weaving yarns, wound in balls or bobbins, are not threaded through tension arms, but are laid across the needles manually.

TECHNIQUES FOR TAPESTRY WEAVING

1. Punchcards which produce a small patterned repeat, such as fairisle cards, will make an all-over textured pattern within the larger colored design. These cards work well with tapestry designs in large, simple shapes. Such a card can be set to regular or intermittent feed, or stopped on one row.

2. For tapestries with more intricate designs, a 1x1 card, such as card 1 from the basic pack provided with Brother/Knitking and Singer/Studio, works best. It selects alternate needles on each row, or can be stopped on one row.

3. On each row, the various yarns being used can be crossed around each other when changing from one to the next as in tapestry knitting, left uncrossed, or spaced with blank needles between. Crossing the yarns will produce a ridge along the edges of each shape, which will emphasize the design. To vary the ridges, the yarns can be crossed by an overlap of more than one needle. Leaving the yarn uncrossed will produce a flat texture, except on verticals, where a space is left if the yarn is not crossed. A softer demarcation of the shapes within the design will also occur. The tapestry woven swatches on this and the following page are made with uncrossed yarns.

4. Spacing shapes with blank needles between them will cause the foundation knitting to show as a border; irregular spacing can be used to produce additional shapes. These areas can be enhanced by eyelets or some other simple pattern.

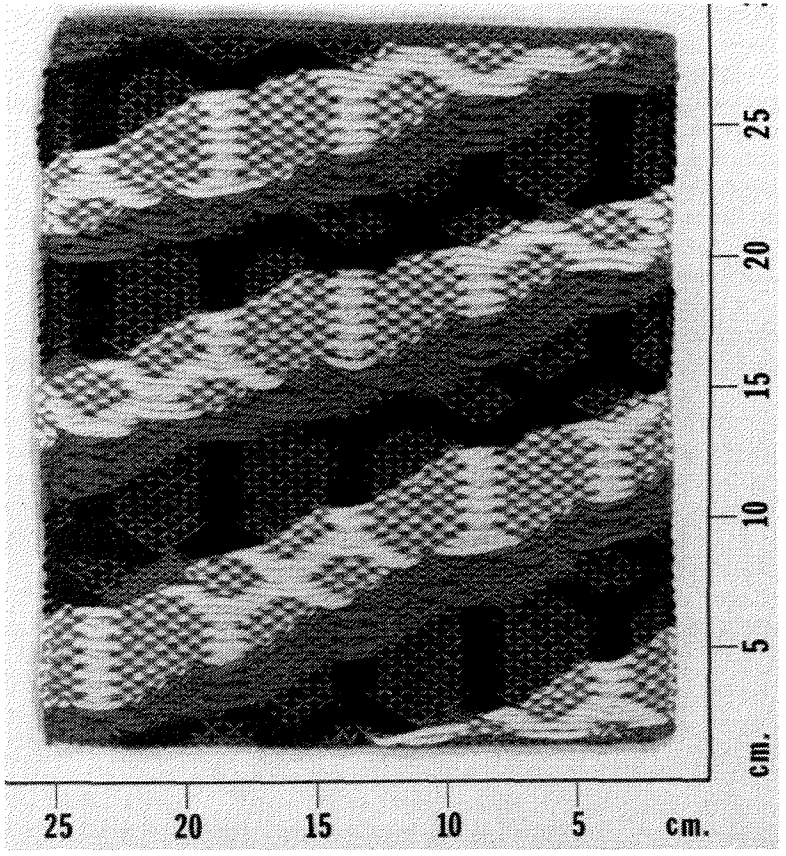
5. Additional surface texture patterns for any of the design areas can be made by wrapping needles for bobbles, or by skipping needles to produce longer floats which will be latched or tucked up.

6. The knit side of the tapestry weaving can be used as the right side, because of the grin-through of the weaving yarn between the knit stitches. Use a thin yarn such as fine rayon, cotton or wool for the main knitting, and heavy rug wool or other bulky yarn for the weaving. There will be slender vertical lines of knitting with the colored pattern showing between them on the knit side.

DESIGNS FOR TAPESTRY WEAVING

Very simple shapes built upon diagonals, verticals and horizontals are best for tapestry weaving. Complex color changes can become confusing in the design and are better suited to intarsia and tapestry knitting.

Freeform diagonal patterns are easy to make using a fairisle card with an uncomplicated pattern. All you need do is move the color change across the needle bed by one selected needle for each row, no matter how the punchcard selects the arrangement. You may skip two needles the first row, three the next, and one the next, depending on the card. All kinds of interesting designs can be created by coupling this technique with a few vertical and horizontal color changes. The angle of the diagonal and the color change design will vary with each card.



Weaving. Jacquard Pattern 1; manual lay-in of weaving yarn. Each color moved R by one selected ndl each pattern row.

Tapestry weaving from a graphed design

If you would like to try working a design from a graphed chart, the following suggestions will make it easier.

1. On Brother/Knitking, use a basic 1x1 punchcard which alternates selection every row. On Passap and Superba, use a pattern ruler to alternate selection each row, as pushers and pattern cards cannot be used.

2. Each needle on the bed will have a corresponding square on the chart. When the design is knitted, both selected and non-selected needles must be counted for each color of yarn. In the swatch illustrated, each diagonal is ten needles wide. Since the punchcard selects alternating groups of five needles each row, laying the yarn for the diagonal was easily done by moving one needle over every row and laying the yarn across five needles each time.

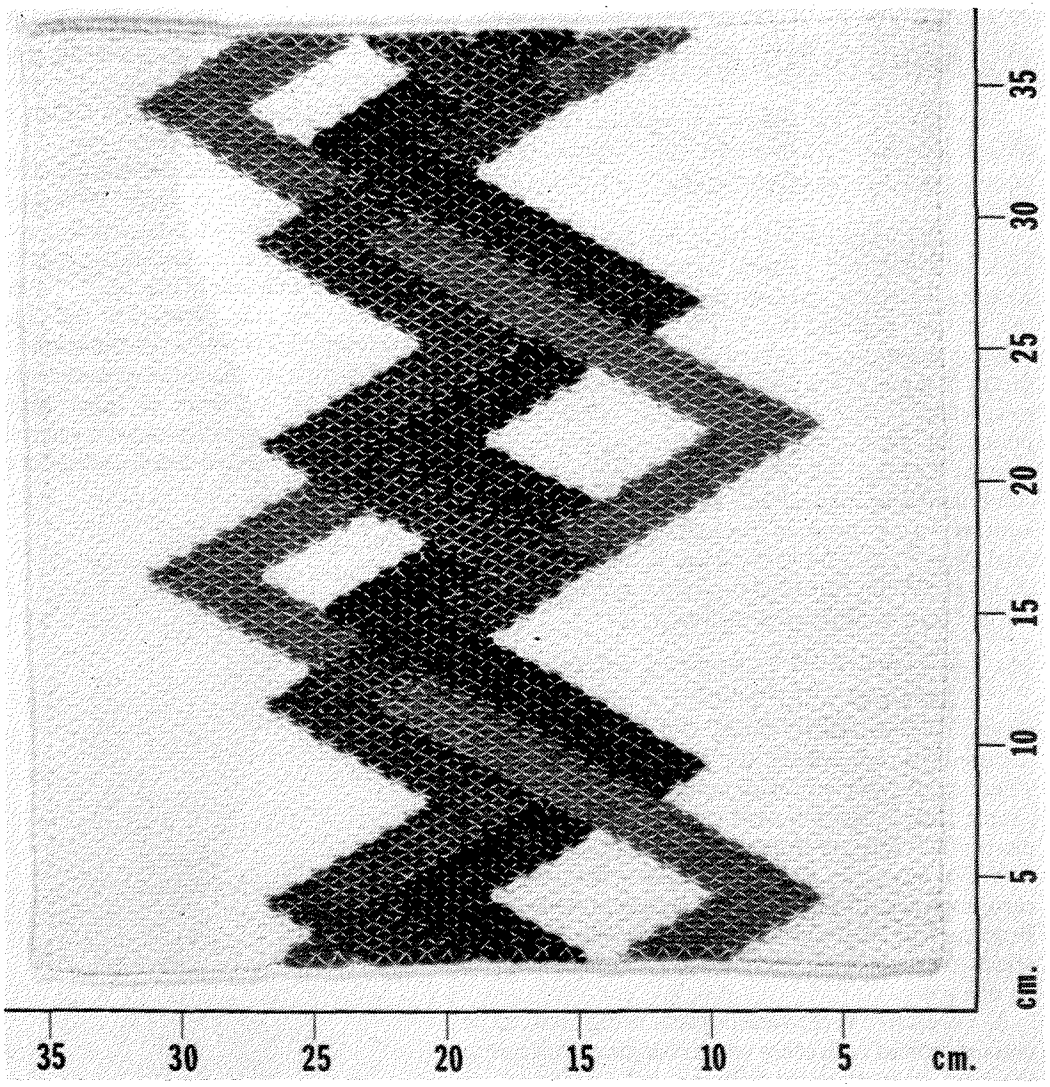
3. On your graph, color the design to match your yarns. Keep in mind that an intricate pattern does not show up well in weaving. A shape that breaks the background into many small areas also can be a problem. You either have to use a separate bobbin for every little area, or manually remove some stitches onto a tool, pass the background weaving yarn behind them, then replace the stitches. This will make a float on the knit side.

4. Since the weaving is done on the back bed on all machines, drop the front bed and cover it with a cloth.

5. A clip clothespin on each bobbin or yarn will even the tension. It also helps to give a slight pull on each weaving yarn as the carriage passes across.

6. The selvedge needle, *on the carriage side only,* should be selected each row to carry the yarn completely across each row. With a 1x1 selection, start the card so the selvedge needle on the carriage side is selected.

7. If a yarn must move more than two needles over from the previous row, it can be woven over and under selected needles to the point where it must start. This is also a good way to start and finish ends of yarn.



Tapestry weaving; 1x1 ndl selection alternating every row. Fine knitting yarn and heavy weaving yarn, so pattern shows through on knit side as well. Pattern diagram from the Intarsia chapter.

PREPARING THE MACHINE
FOR TAPESTRY WEAVING

Use only the back bed with the back bed carriage. Drop the front bed to its lowest position and cover it with a cloth or ribber cover. Cast on the back bed with either waste yarn or main yarn, using comb with wire. Put the weaving brushes in working position. The comb and weights will hang between the beds, while the yarn ends from the balls of weaving yarn on the floor are brought up on top of the front bed, not between the beds. The main yarn remains in the yarn tension unit and is threaded in the back bed carriage throughout. Always move the carriage slowly when knitting the stitches. Following are specific instructions for the different machines.

Passap. Use black strippers, comb and weights. The main yarn is fed through the tension unit and feeding eyelet in the carriage, as usual. After casting on, drop the front bed, and uncouple the carriages. Leave the front carriage at the left end of the bed throughout, as it is not used. Cam is set to N, no pushers. *With pattern ruler or Jac 40, push up selected needles so hooks are above the sinker posts but *stitches are still on the latches.* Lay the weaving yarn across the latches of the selected needles, allowing it to lay against the sinker posts. Move the carriage across with the main yarn, giving each weaving yarn some tension as the carriage passes across.* Repeat for each row.

Since the front bed does not drop very far, it may be easier to weave if the yarn ends are between the beds rather than brought up over the front bed.

Superba. Since the front bed is in the dropped position, you may wish to use the knitting retainer accessory, although the action of the weaving brushes is usually enough to hold the knitting against the bed. The main yarn is fed through the carriage; the cam set for knit. *With the pattern ruler or Jac 40, bring selected needles to position 2. Make sure stitches are still on the latches. Lay the weaving yarns across the needles next to the sinker posts, and move the carriage across.* Repeat for each row.

Brother/Knitking. Use a punchcard in the reader to select needles. Thread the main yarn in the carriage as usual; set cam to plain. Needles are automatically selected to patt pos each row, with stitches still on the latches, so weaving yarn can be manually laid across the latches next to the sinker posts. The needles will knit back and automatically select for the next row with each pass of the carriage.

Singer/Studio. Needles can be brought forward to C position automatically by using a punchcard in the reader. It is easiest to use card 1 from the basic pack (1x1 alternating selection). If you wish to use a different pattern card, it must be locked on the first two passes of the carriage, then unlocked on the third pass, each pattern row. Have main yarn in the carriage as usual, and weaving brushes in WP. Put card 1 in the reader, knit a row to set the memory, then unlock the card and set it to rotate ER. *With cam on slip, and leading side lever back, open the lid of the carriage. Pass the carriage across (ndls are selected to C pos). Now bring the leading side lever forward, with the lid still open, and pass the carriage back across to the starting side. Lay the weaving yarns across the needles next to the sinkers. Close the lid, set cam on stockinette, leading side lever forward, pass the carriage across. The stitches have all knitted and the carriage is ready for the next pattern row.* Repeat. Three passes are required for each pattern row. The punchcard rotates each pass, but because the alternating selection is continuous on the card, the pattern will be knitted correctly.

WEFT KNITTING

Weft knitting, also called *inlay, laying-in,* or *insertion,* is a double bed technique in which an extra yarn is laid manually between the two beds, then enclosed by stitches when the main yarn in the carriage knits over it. In many ways, it is the double bed counterpart of weaving, and like weaving, produces a stable fabric which stretches in the width only as much as the weft yarn itself will stretch.

The most basic weft knit fabrics are those knitted with fine yarn in either full needle rib, interlock, or one of the knit-weaves. The weft, also a fine yarn, is inserted every row or every other row. The weft yarn doesn't show in the finished fabric unless some needles are in non-working position on one or both beds for patterning.

The resulting fabric is firm and smooth; it has body without being bulky, and is an excellent cut-and-sew fabric for suits, pants, and coats. When knitted of heavier yarn, with linen or cotton weft, it maintains its shape well and is ideal for hat brims, handbags and rugs. If an elastic weft thread is used, you can knit snug-fitting cuffs and waistbands—and even bathing suits.

By making changes in both the knitted fabric and the weft you use, you can create some really interesting patterns. Below are a few suggestions for variations.

Leave out a few needles on one or both beds for ribs or panels. These can be knitted in tuck, Fisherman's Rib, or in a lacy or embossed jacquard pattern. The weft will be exposed in the open spaces. By leaving out the weft yarn for several rows at intervals, or changing color or texture of the yarn, you can create different plaid designs.

Try a fancy yarn—thickly textured, brushed, or slubbed—or knitted cord, ribbons or crochet chains for the weft. Use a needle arrangement like the one described above.

String beads or other small objects on the weft yarn. Space them carefully when laying them in so they will show through the stitches in appropriate places. Tasseled upholstery trims are interesting, too.

Allow the weft yarn to hang out at the selvedges of the fabric, like fringe.

Combine weft knitting with racked ribs, and, especially when using cross bed transfer carriages, with embossing. Coupled with ribs or embossing techniques, several rows of exposed wefts can be grouped and hooked over chosen needles or latched up in various ways to form background patterns for the embossed design.

Individual lengths of weft yarn can be stopped or started in the middle of a row, with the ends hanging out between stitches to form fringes within the body of the fabric. Loops of weft can be pulled down between the stitches and cut or knotted, or strung with beads after knitting.

If a slippery weft yarn is used, the knit stitches can be pushed together or pulled apart to form patterns resembling smocking or drawn thread needlework, and can be secured with embroidery stitches.

WORKING WITH THE WEFT YARN

There are several methods by which a continuous weft thread, as opposed to cut lengths, can be laid in.

Which you choose will depend whether the weft is thick or thin, what kind of fabric is being knitted, the ease of knitting it on your machine, and experimentation and practice.

Superba is the only machine with a special attachment for weft knitting; it is part of the PTV device, and can only be used with finer yarns, since the feeding hole for the yarn is very small. The yarn is fed through the tension arm and the attachment lays in the weft at an even tension every row (rows cannot be skipped) just ahead of the knitting yarn. If heavier yarns are used, the yarn must be laid in manually just prior to knitting the row, as is done with other machines.

The weft yarn is wound on a cone or ball too large to pass between the beds.

Method 1. Thread the weft yarn through a tension arm but not into the carriage. Anchor the free end between the beds on the *same side as the carriage.* Lay the yarn between the beds and across the stitches and hold it out toward the end of the bed, pulling down slightly so that the needles don't catch in it. Move the carriage threaded with the main yarn across. Uncouple the carriages, pass the weft yarn between them, recouple them, hold the weft yarn in the opposite direction, and pass the carriage across again.

Method 2. Do not thread the weft yarn through a tension arm. Instead, place the yarn at your feet at one end of the beds. Anchor the yarn end somewhere under the beds. Use a hook to pull up a loop of yarn from between the beds—it will be doubled—and lay it across the stitches. Knit or hook the loop around the selvedge needle on the opposite end of the bed to anchor it. For tension, pull down slightly on the yarn from underneath, then move the carriage with main yarn across, from either direction. Repeat, pulling up another loop and anchoring it as before. Here, the weft yarn is always doubled, always comes up between the beds from the same end, and is always anchored on the same selvedge needle. In cases where the weft is exposed at both selvedges, the yarn should be anchored on both selvedge needles.

The weft yarn is wound on a card or bobbin small enough to pass between beds.

Method 3. Anchor the weft end between the beds at either end. Lay the yarn across the stitches and drop the bobbin or card between the beds. Pass the carriage with the main yarn across. Push the card up between the beds, lay the yarn across and again drop the card between the beds.

Method 4. Instead of dropping and bringing the card up from between the beds, uncouple the carriage and pass the yarn through as in the first method given above. The card or bobbin may be small enough to pass under the carriages without uncoupling.

In both of the above methods, it is best to lay the weft in the same direction that the carriage is moving, as from right to left when the carriage will knit from right to left. Otherwise, with many yarns, the weft tends to catch in the brushes if it is laid opposite to the direction the carriage will move. Cut lengths can be laid in anywhere; just be sure to hold the ends securely from underneath the bed when they are being knitted across.

The needles on each end of *both beds* must be knitting every row to carry the weft completely to the edge of the fabric. If the selvedge needles on one of the beds are in non-working position, the weft yarn must be anchored around the end needles, to carry it to the edges of the fabric. Maintain an even tension on the weft yarn every row, so the selvedges will be even.

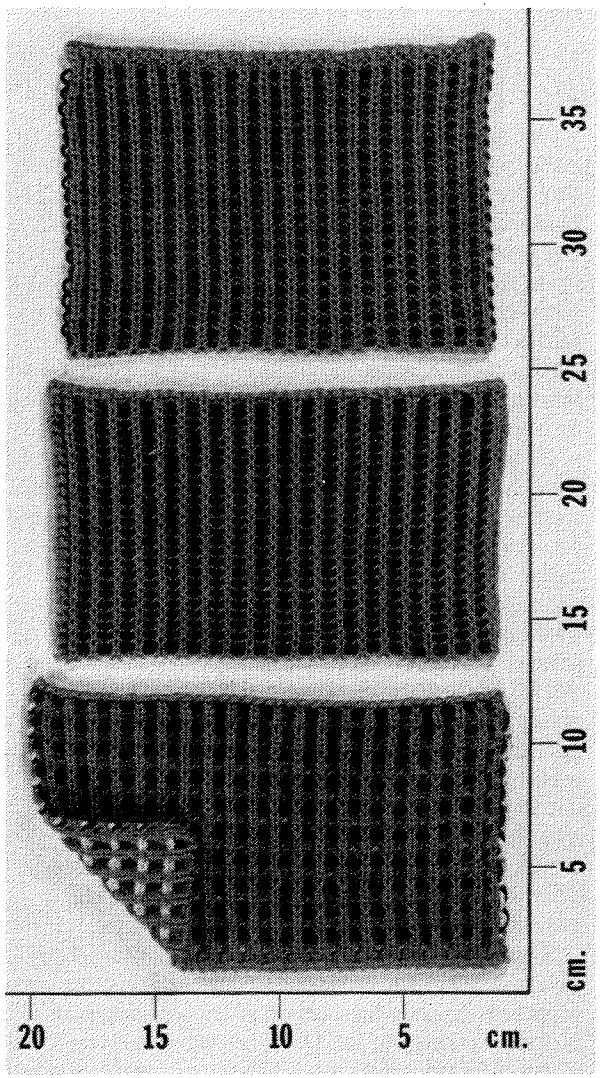
More pointers for weft knitting

To knit cut-and-sew fabrics, use a fine yarn for both weft and knitting, and use a fairly tight stitch size. The weft yarn should be somewhat rough or hairy so the knit stitches won't slide over it and become displaced in the finished fabric.

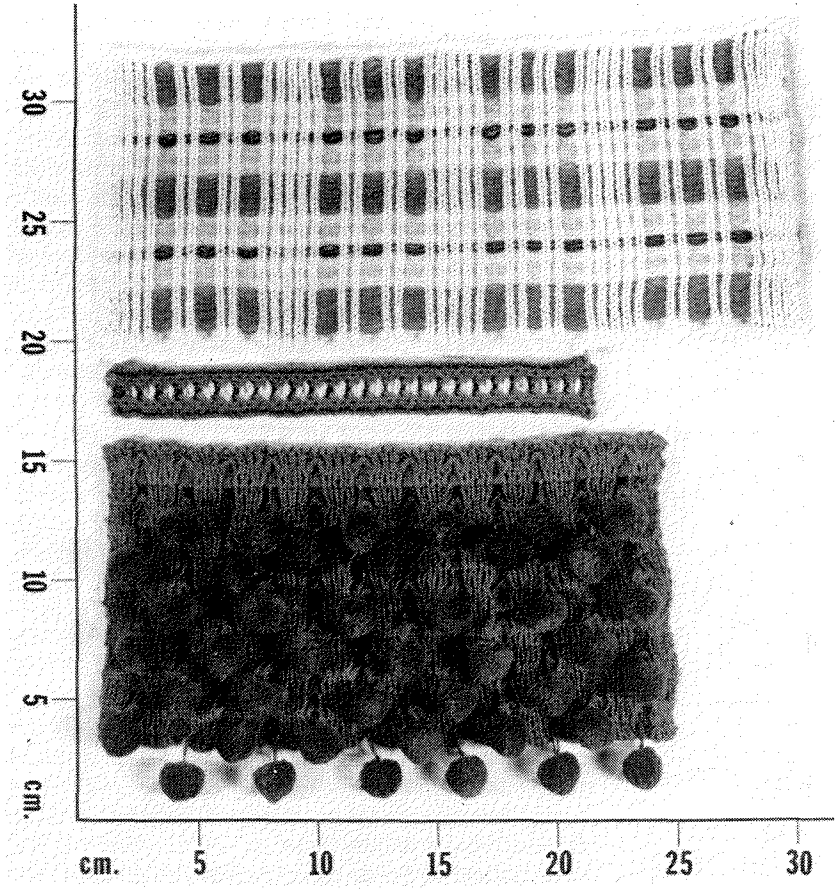
Elasticity across the width of the fabric is determined by the stretchability of the weft and how tightly it is laid in. Cotton, linen, and tightly spun wool are the least elastic and are usually rough enough to hold the knit stitches in place. A soft or loosely twisted weft will contract the fabric more and will give it more elasticity.

The weft yarn, if it isn't too heavy, can be wrapped once or twice around hooks of selected needles on one or both beds, or wound back and forth from hooks on one bed to hooks on the other, then knitted down on the next row. Bobbles and selective patterning can be done this way.

When beads, weft ends or tassels are placed in the middle of the fabric, they must be pushed or pulled down below the needles to the outside of the fabric underneath the beds so they won't interfere with the passage of the carriage or movement of the needles.



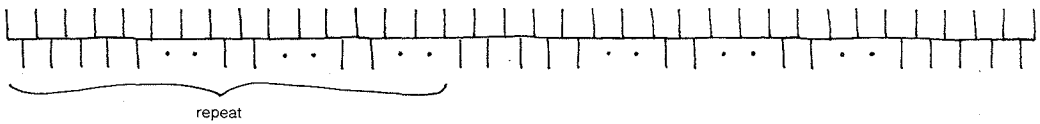
Weft knitting; patterns based on 1x1 rib needle set-up.
Top: plain knitting on both beds; weft laid in every 2 rows by Method 2. Both faces of fabric identical.
Center: full fishermen's rib; weft laid in every row by Method 1. Both faces identical.
*Bottom: knit/tuck pattern with 2 colors of weft, using Method 2. One color shows on each face, making a waffle pattern. *Set back bed cam to knit; front bed cam to tuck. Knit 4 rows, lay in col 1. Set back bed cam to knit, knit 4 rows, lay in col 2.* Repeat.*



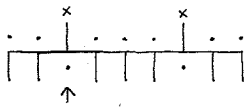
*Top. Weft knitting. Plaid pattern made by combining needles in NWP on one bed with several colors of weft. MC (light) knits vertical rib and is threaded in the carriage, with both cams set to knit. Wefts are laid in every row in each group, spaced by RC2 with the MC alone. *8 rows, col 1; 2 rows col 2; 2 rows col 3; 2 rows col 2.**

Center. Weft knitting; braid. MC knits front bed ndls continuously; back bed ndls (marked x) tuck 2 rows, then knit 2 rows. After the 2 x ndls have tucked 2 rows, bring up a double strand of weft from between beds at the point marked with an arrow, hook it around the center group of 3 ndls. After the 2 x needles have knitted twice, and tucked again twice, bring the weft up again. Beads can be prestrung on the weft and positioned where desired. The front of the braid is the side knitted on the back bed.

*Bottom. Weft knitting. Special method for inserting wide tapes, ribbons, braids. Tape in swatch is ⅜″ wide, with tassels 1½″ apart. *Knit four rows on both beds, SS as for rib. Knit four rows on the back bed alone, then four rows on the front bed alone, SS for stockinette. Drop the bed, insert fringe, pushing tassels through the space under the four floats, every other space. Hook the four floats together on the x needles.* Repeat.*

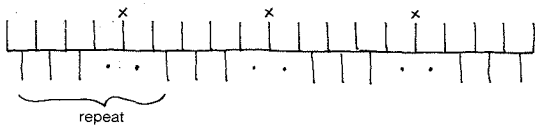


Set-up for plaid pattern.

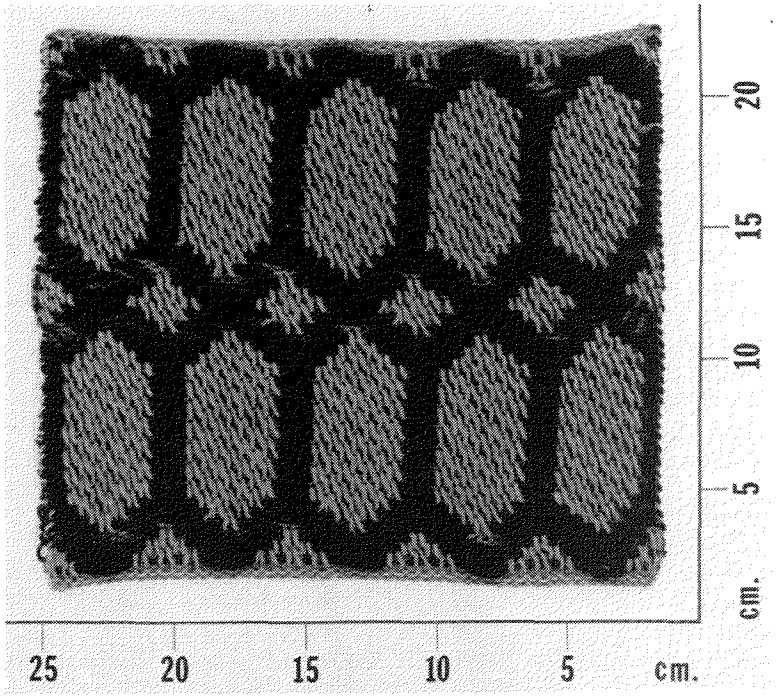


Set-up for braid.

Set-up for swatches shown on adjacent page.



Set-up for tape with tassels.



*Weft knitting. Cross bed transfer pattern, using jacquard Pattern 1. Set MB cams to knit selected ndls on first pass only; second pass slips completely. Second bed knits both directions. Punchcard Type A-1, rotating EOR. *Knit 2 rows, lay weft as in Method 2, anchoring it on selvedge needles, then transfer MB stitches to second bed.**

VERTICAL WEAVING OR EMBROIDERY KNITTING

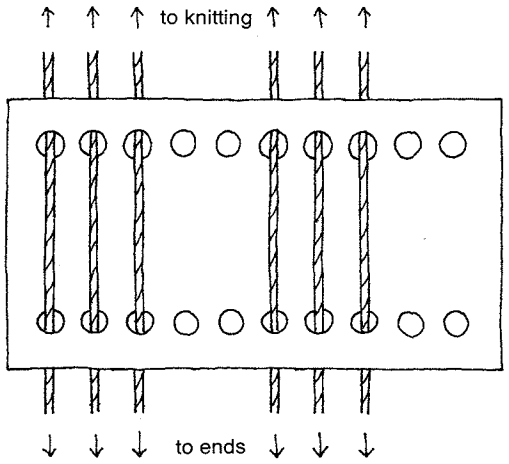
Vertical weaving works according to the same principle as horizontal weaving except, as its name implies, the weaving yarns are laid in vertically. The backing is knitted as in regular weaving: in stockinette, with the purl surface as the right side, and always on the back bed. The same yarns and fabric variations can be used.

Vertical weaving differs from horizontal weaving in that it is strictly manual. Each vertical row of weaving requires one end of yarn. If there are many ends, each end is threaded through a hole in a card or an eye in a garter bar or multi-decker stitch holder to keep even tension and spacing and to prevent tangling. All needles involved in the patterning are moved out to patterning position together, either manually or with a punchcard. The yarn ends in the holder are either wrapped or hooked over the chosen needles, and the needles are then knitted back with the main yarn in the carriage for one or two rows before again bringing needles forward for wrapping. Weaving brushes are not necessary unless horizontal weaving is included in the pattern.

To make the patterns, the holder can be moved back and forth across the needle bed, with different needles selected each time they are wrapped. All the ends are wrapped around needles simultaneously. With a little practice, this can be done quickly and efficiently. If there are only a few yarn ends a holder is not necessary; the ends can be wrapped individually. Patterns can be charted on a graph, as illustrated in this chapter, or found in many of the older pattern books for the Japanese machines.

HOLDERS FOR YARN ENDS

Punched cardboard. Use a piece of lightweight cardboard about three or four inches wide and long enough to accommodate the number of ends you plan to use. Mark off spaces along the top and bottom of the card corresponding to the needle spacing on your machine, then punch out two rows of holes, about one-fourth inch from the top and bottom edges—one hole for each marked space. To measure the spacing, for Passap and Superba machines, use a metric ruler and mark off every 5 mm. For Brother/Knitking and Singer/Studio, use a blank punchcard. With a sharp pencil, mark through the small holes in the center of each grid space, which are 4.5 mm apart. To thread the card, start from underneath the card, thread the yarn ends up through the bottom holes, then down through the top holes. To prevent the yarn from slipping through the card too quickly, attach a strip of card across the bottom holes with a paper clip after threading. If more weight is necessary to maintain good tension, tape some coins to the card or use clip clothespins.



Homemade yarn holder for vertical weaving.

Garter bar and multi-decker stitch holders. The newer garter bars, for Brother/Knitking and Singer/Studio, come with a rigid-backed foam strip and two clips expressly for vertical weaving. The eyes in the 50-needle section are threaded from below, then the yarn ends hanging on the front side are held down by the strip and the clips. To use the 100-needle section, cover the ends with cardboard strips held in place with clothespins.

The multi-decker stitch holder can be used for Passap and Superba if the yarn isn't too bulky. Thread the ends through the eyes; hold them in place with a strip of cardboard and clothespins.

Open-ended use of the garter bar and multi-decker stitch holder. The garter bar and multi-decker stitch holder can also be used for thick yarns, or to add beads or other decorative objects too large to fit through the eyes. And they can be used to change the spacing of the yarn ends during the knitting. Thread the yarn ends *between* the teeth of the garter bar or between the prongs of the multi-decker stitch holder. To hold the yarn in place on the garter bar, fold a strip of heavy paper in half over the eyelets at the ends of the teeth and secure it with a paper clip. On the multi-decker stitch holder, place the cover over the eyes and push the ends up under the cover. Then, with a paper clip, attach a strip of cardboard on top of the prongs to hold the ends up near the cover. To respace the ends, or to move a large bead into position over the knitting, just remove the covering over the eyes of either tool.

TECHNIQUES FOR VERTICAL WEAVING

1. A small ball for each end of yarn can be placed on the floor. If there are too many ends, they can be measured and cut instead, then rolled up on a bobbin or rubber band. A good rule of thumb for measuring is to cut a length of yarn six times the length of the finished fabric and fold it in half to make two ends.
2. Thread the ends through the holder in the desired spacing.
3. To anchor thread ends to the start of the knitting, pull the needles out to patterning position, hook the folded part over a needle hook, and knit back with the main yarn in the carriage. Or lay each cut end over a hook, leaving a three- or four-inch tail which will be fastened and cut after knitting. In our patterns the ends always begin as pairs. Adjust the yarns in the holder four to six inches away from the knitting and begin the pattern. As the knitting progresses, keep moving the holder back, letting it hang down while knitting across with the main yarn in the carriage.
4. To knit each pattern row, lay the weaving yarns over the hooks of chosen needles, either from left or right. The yarn can be brought up to the hooks from the previous row by crossing under the hook first; that is, by shifting at least one needle left to right from the previous row; before laying the yarn over the hook. This will create a loop effect, as seen in the diagram. If the yarn is brought up to the same needle as on the previous row, it will create a step effect.

All the ends move together, remain the same distance apart, and will wrap the same way. You can alter the effect by knitting more or fewer rows between wrappings, by changing selected needles back and

forth across the bed, or by wrapping more than one needle at a time with more than one wrap, which will make bobbles.

5. If you are working from a graph, the needle selection can be made manually with a pattern ruler, pushing all the needles out at once; or with a selective pattern ruler to select only those needles you want to wrap. Except on Passap, a punchcard can be used to select either all needles (with the card reader locked; no punchcard), or pattern needles on Japanese machines.

VARIATIONS IN PATTERNING

Vertical weaving is so versatile that many variations are possible in the technique. You might like to try a few of the ones below.

Change the spacing of the yarn ends in the holder during the knitting.

Add beads or other small decorative items.

Hook two or three yarn ends together over the same needle occasionally.

Use two different holders at once with the same pattern. Move them in opposite directions, either on opposite sides of the center of the fabric, or in alternating bands, which can be vertical or diagonal and can cross each other to form diamonds or other shapes. Or use two different holders to create two patterns in different colors, knitting simultaneously, one on top of the other.

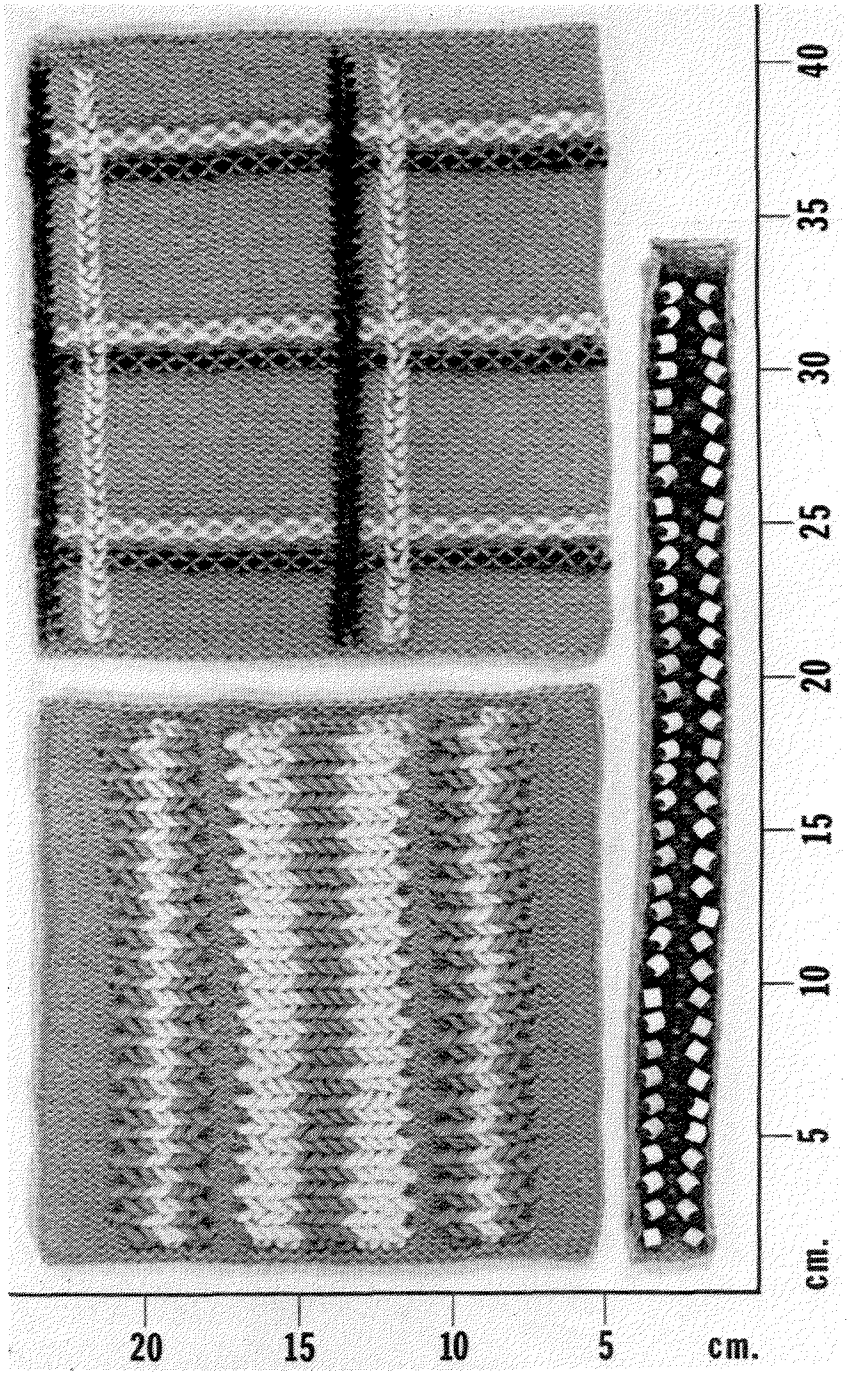
At intervals, turn the holder over, or cross two holders so the yarns are twisted. This works best with narrow panels, each on a separate holder, or when the yarns are on open-ended holders.

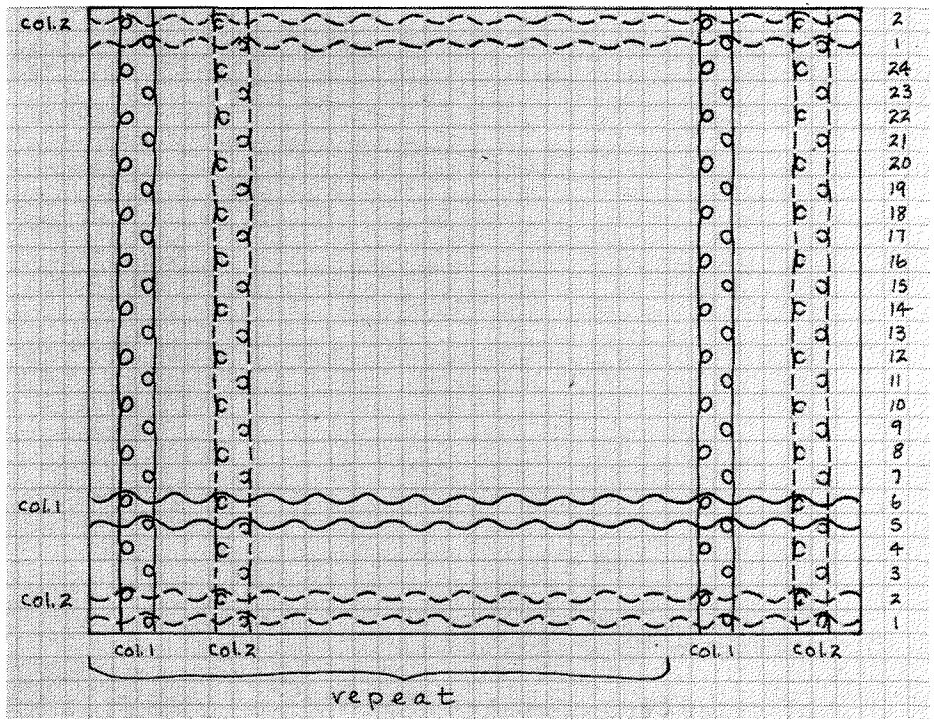
Try plaids or other patterns knitted in combination with regular horizontal weaving.

Weaving with a thick cord can be done vertically as well as horizontally, as described in the first section of this chapter. Remove one or several stitches onto a transfer tool, move the cord behind the knitting either from the left or right, then replace the stitch. Do the same for each cord across the knitting. Knit several rows plain, then repeat.

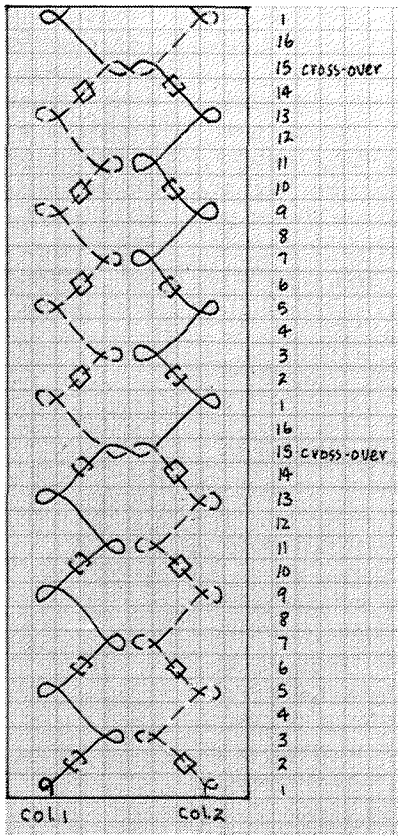
Vertical weaving is also useful for tacking down long floats in jersey jacquard patterns. Thread the holder with yarn the same color as the stitches. Then wherever necessary, loop the ends over needles carrying the appropriate color to enclose the floats from the design.

Vertical weaving.
Top. Pattern 1. One holder with 2 colors. Combined with horizontal weaving, using a 1x1 basic punchcard for both vertical and horizontal selection.
Bottom. Pattern 2. One holder with 2 colors.
Side. Pattern 3. Braid using 2 ends, prestrung with beads. No holder needed.

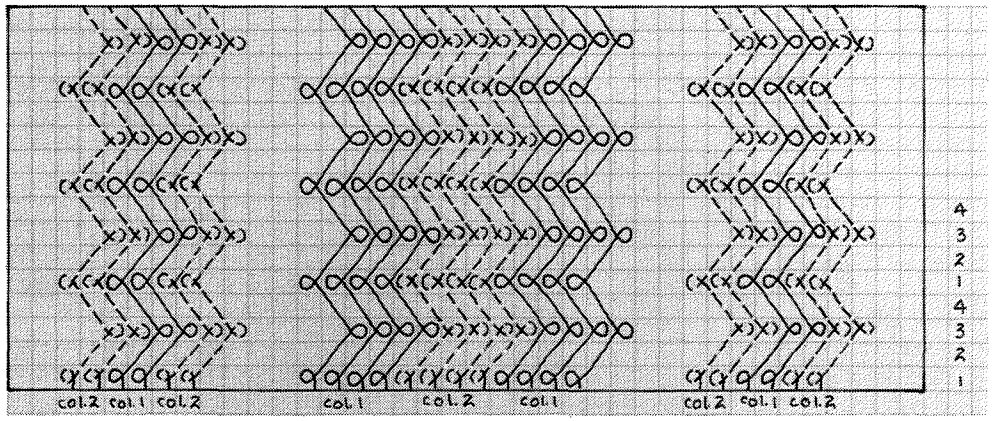




Pattern 1

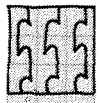


Pattern 3

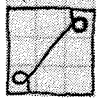


Pattern 2

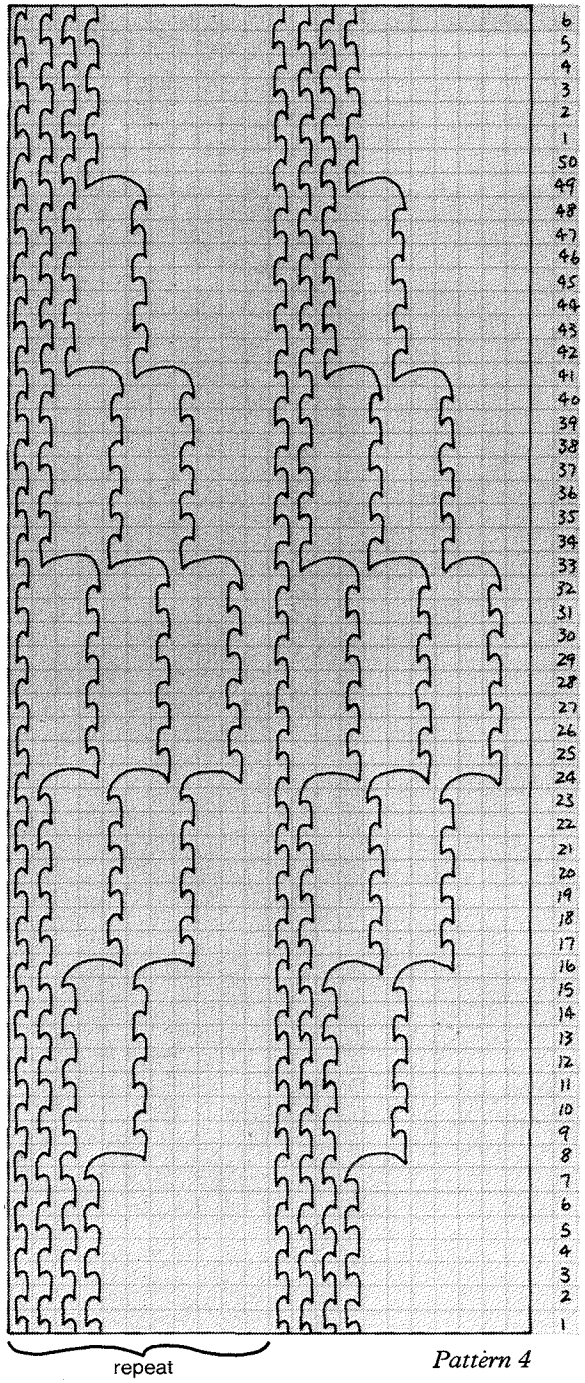
Key to vertical weaving symbols. Each square = 1 row and 1 stitch. Lines show movement of weaving yarns.



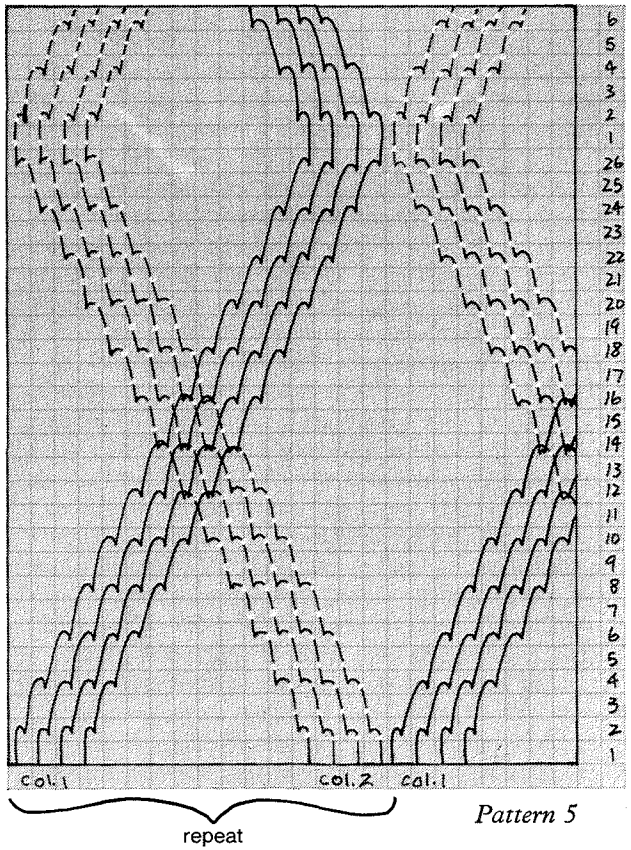
Yarn is brought straight up from row below and laid over needle, from left to right, then right to left on successive rows. Shown ER.



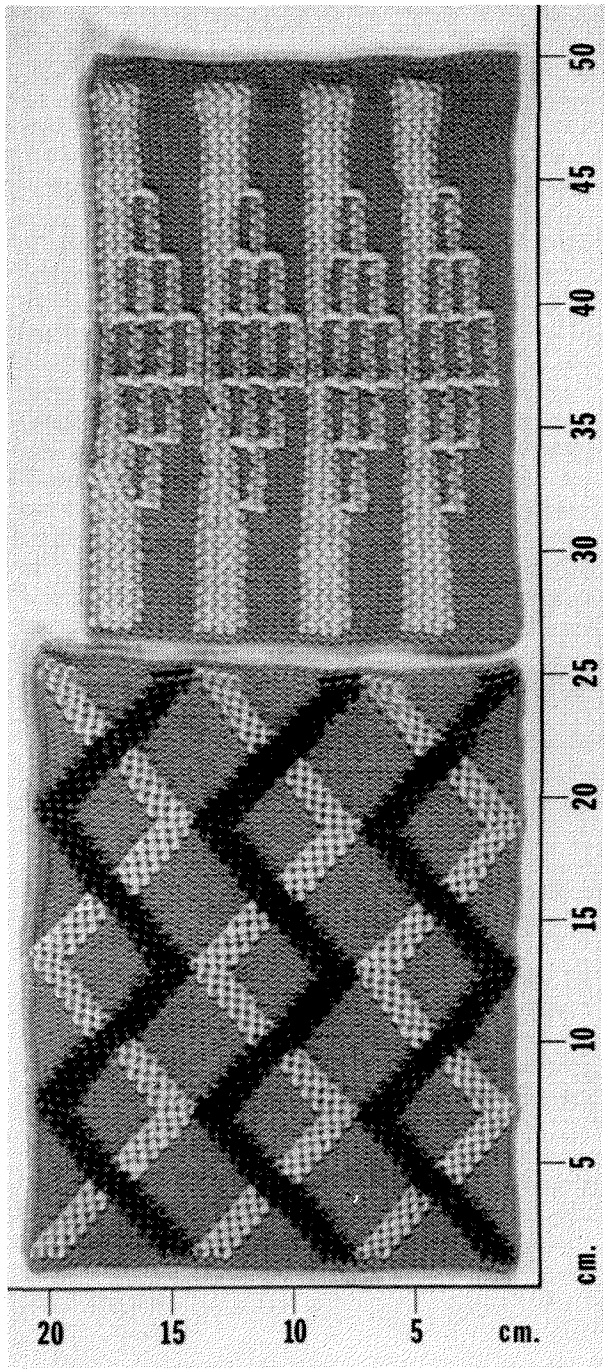
Yarn is moved around under needle before being brought up for next wrap, from left to right. Shown 2 needles to right, with plain knit rows between.



Pattern 4

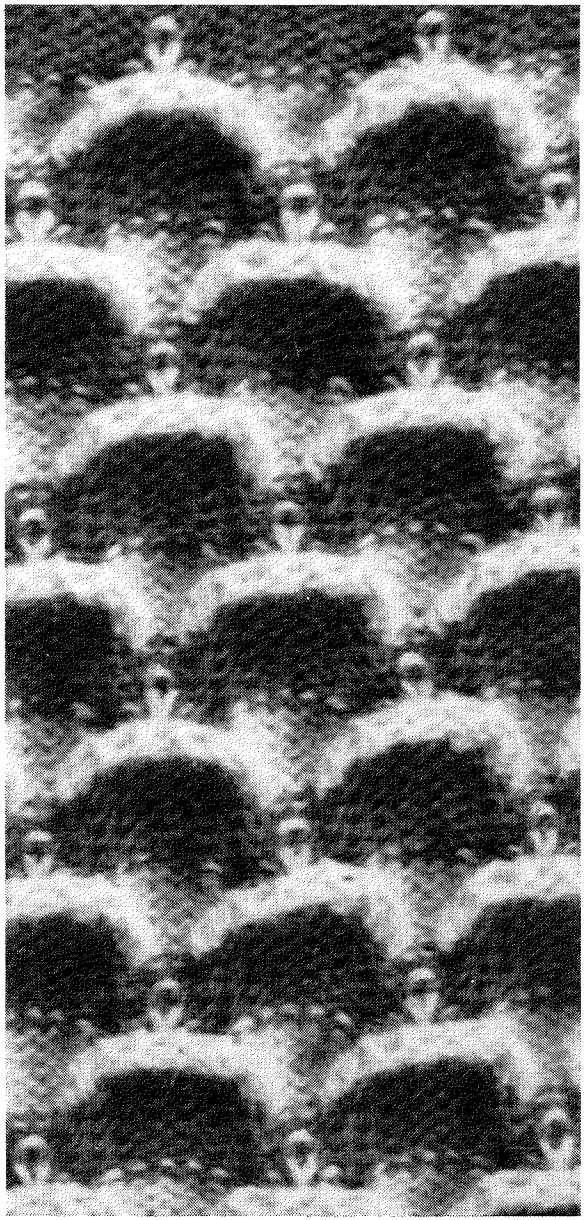


Pattern 5



Vertical weaving.
Top. Pattern 4. One open-ended holder with one color.
Bottom. Pattern 5. Two holders, one for each color. Both colors hang on ndls together during crossing of colors.

CHAPTER 12
Embossing



In knitting, to emboss means to raise, or put into relief, a design, panel or rib so that it stands out from the background fabric. Embossing can take many forms, from an all-over texture to isolated segments, and can be done in almost any technique.

All-over embossed textures are familiar in single bed tuck, slip stitch and weaving techniques, and in double bed pile, blister, lace and ripple patterns. All are easy to make automatically with or without a punchcard; patterns and instructions for them can be found in most pattern books as well as in this book.

This chapter deals with embossing methods not discussed in other chapters: those which produce double-knit patterns on a single bed background fabric; and those for single bed knit/purl fabrics made double bed. Several of the techniques require transfer carriages—either lateral or cross bed—although stitches can also be transferred manually with decker tools. Many of the following techniques and designs can be applied to embossed fabrics introduced in other chapters. We leave it to you to experiment with them.

When embossing is done double bed, the background fabric is knitted in purl stitches on one bed, and the raised design or panel in knit stitches on the other. This can be done by two different methods. The first produces double-knit patterns where all needles are working on the backing bed, coupled with selected needles for the pattern on the opposite bed. The embossed portion will be a double knit with a rib structure, and will show in definite relief on the flat, purl stitch background.

The second method produces knit/purl, or damask, patterns, where needles are left out on the backing bed behind the pattern needles on the opposite bed. Often seen in cables, basket-weave patterns, and ribs, it actually is a stockinette fabric produced on two beds; that is, the knit stitches are on one bed and the purl stitches on the other. The fabric will have more elasticity across the width than will fabric made by the first method.

DOUBLE-KNIT EMBOSSED PATTERNS

The backing for these can be either stockinette or 1x1 tuck/knit, with needle selection alternating every row.

One- and two-color vertical ribs. To make vertical ribs or panels, put the number of needles required for their width into working position on one of the beds and maintain this arrangement during knitting. These ribs and panels, with needle selection by punchcard or pushers for two-colored ribs, can be combined with racking or cross bed transfer to produce a great variety of embossed designs. The ribs themselves can be knitted on either bed, although usually they are put on the main bed so a punchcard can be used for two-color selection. On Passap, Superba, and Brother/Knitking, plain or colored ribs can be combined with 1x1 selection on the backing, made automatically with pushers and arrow keys or the lili buttons. Singer/Studio knitters must decide whether to use the punchcard for a 1x1 backing with a one-color rib, or to use it for selecting needles for a two-color rib with a plain stockinette backing.

Rib patterns can be modified in many ways. The following are a few suggestions:

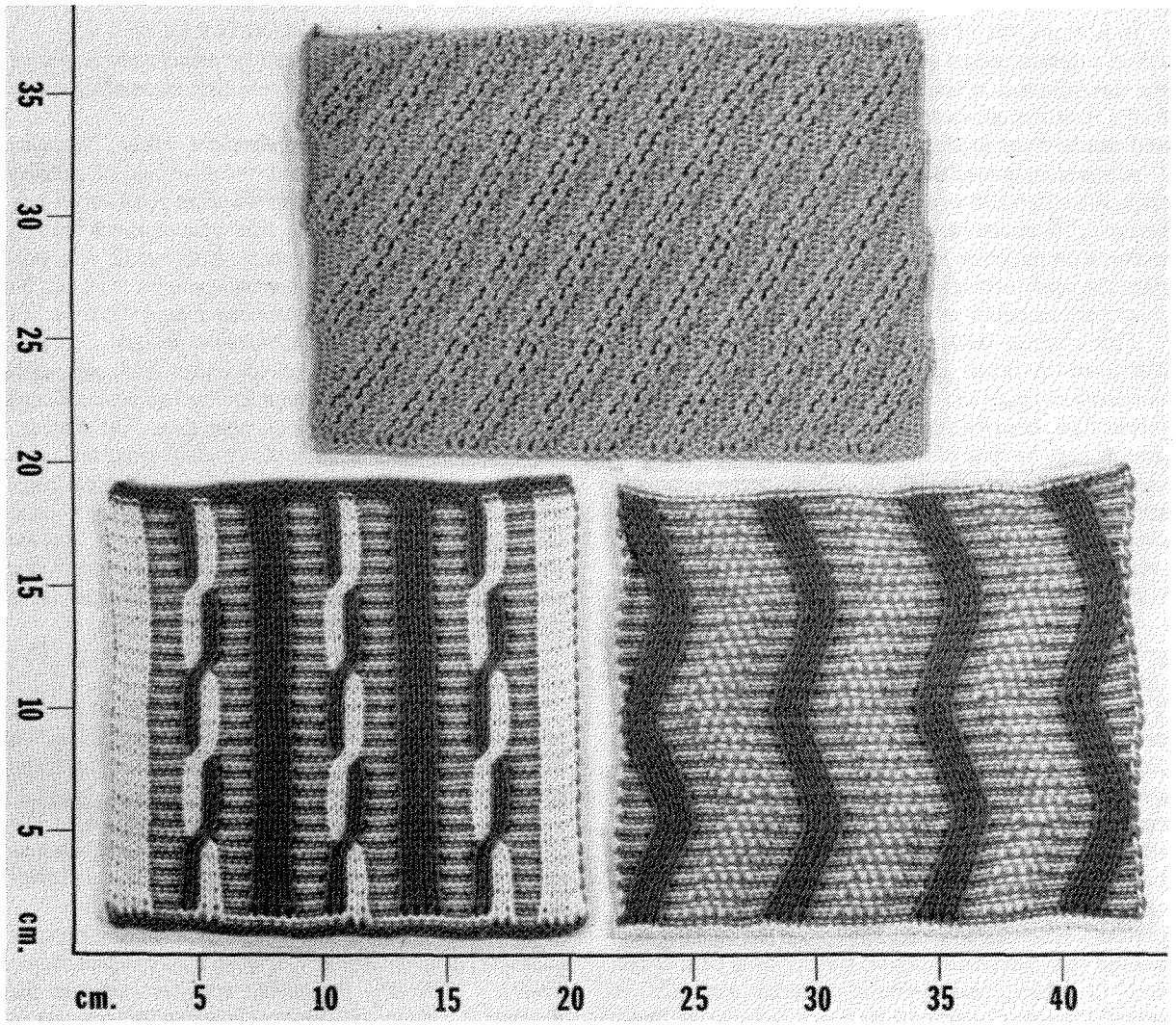
Use needle selection to knit two-color ribs in alternating colors. The purl stitch background will be in a two-color horizontal pattern contrasting with the two colors in the vertical ribs.

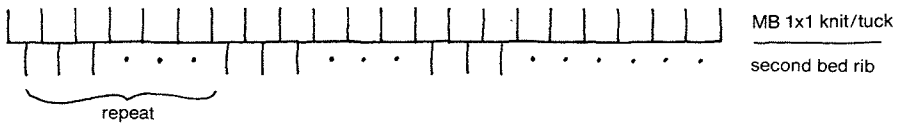
Cable a pair of adjacent ribs.

Try racking. It will add a new dimension, such as diagonal patterning in the ribs; or, when coupled with cross bed transfer, a checkerboard pattern.

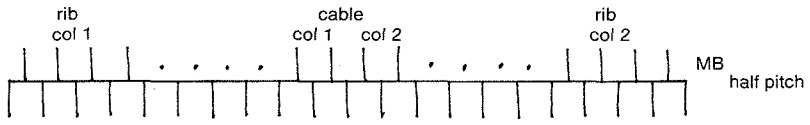
Transfer stitches to the backing (alternating ribs, for example) either manually or with a transfer carriage. Passap's U-80 and the ribber transfer carriages for Brother/Knitking and Singer/Studio allow transfer of selected stitches, but manual transfer is not difficult if you want to transfer only certain ribs.

If, when you start new ribs, you want eyelets at the base, simply begin knitting again on the empty needles. If you don't want eyelets, hang the purl loops from the adjacent stitches (not the sinker loops, which are *between* two stitches) on the opposite bed first, then begin knitting.





Set-up for swatch at top in the photo.



Set-up for swatch at bottom left in the photo.

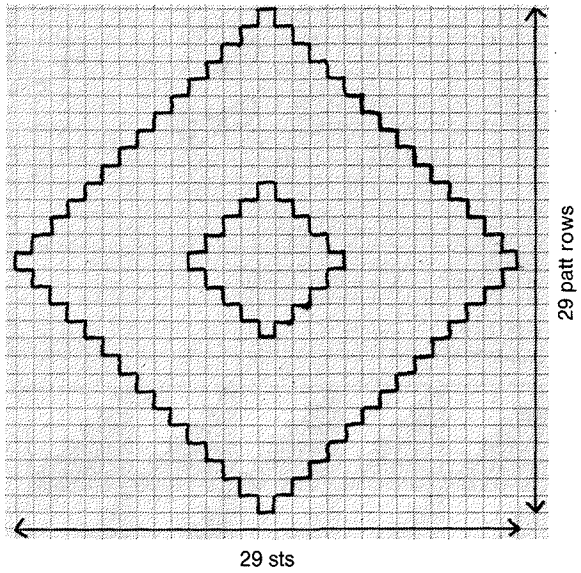
*Double-knit patterns with one- and two-color vertical ribs. Top. One-color racked rib on 1x1 knit/tuck backing. Set up needles with beds racked all the way to one end. *Knit 4 rows, rack one space* 6 times. Transfer rib sts to backing, rack to beginning position and repeat.*
Bottom left. Two-color ribs on stockinette backing. A punchcard or pushers can be used to select needles for each color rib (2 rows each color) while the backing knits all rows. Ribs will be in Long Stitch or Half Milano, because the backing will contain twice the number of rows as will the rib fabric. If cables are included, as in this swatch, needle selection for the 2 colors must be reversed at the cable crossing. The backing could also be in 1x1 knit/tuck.
Bottom right. Two-color ribs on stockinette backing. Use the same needle set-up and knitting sequence as for the swatch at bottom left. In addition, beds are racked one needle each sequence, at which time the stitches in one of the rib colors are transferred to the backing. This is a cross bed transfer, and makes a mock garter stitch texture.

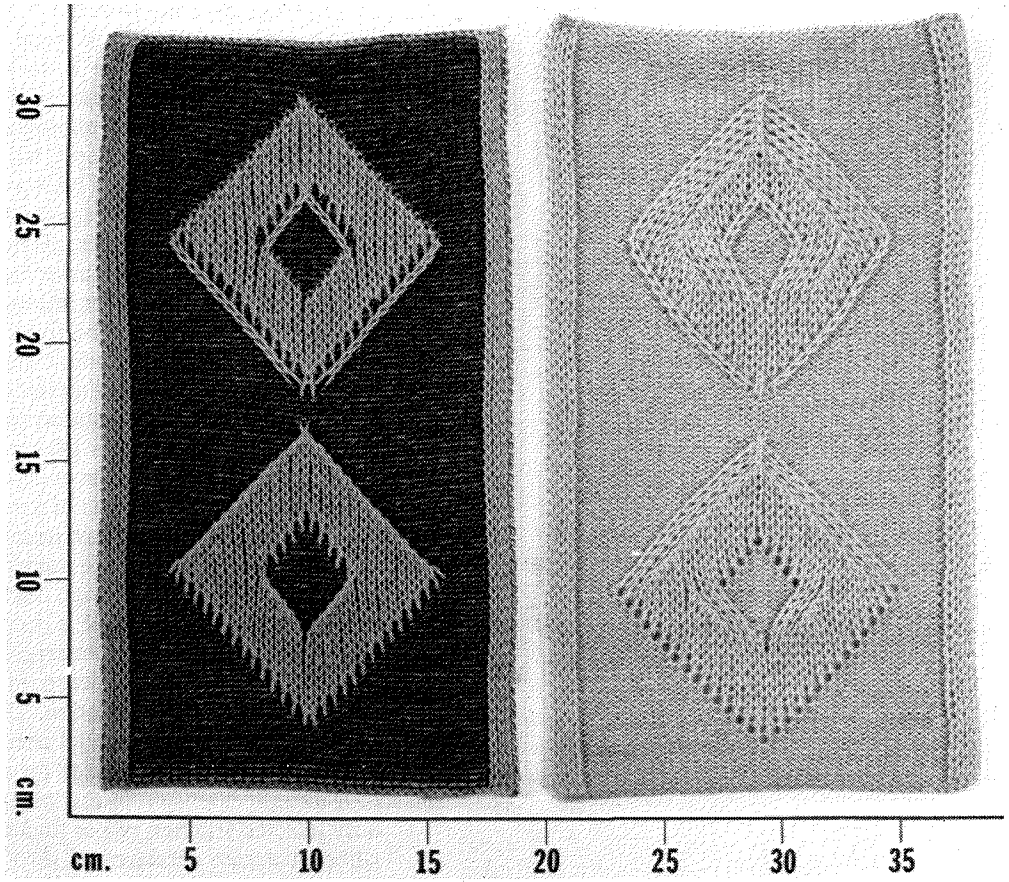
Embossed Shapes Knitted Manually With Lateral and Cross Bed Transfers

To emboss shapes other than vertical ribs, panels, or checks, the number of working needles making the design has to be changed, often every two rows. These needles are used to form both the outside shape of the embossed design, and the elements within it. The size of the shape can be increased by simply adding more edge needles where necessary, allowing them to begin knitting on the next row. Or, a decorative effect can be achieved by first transferring some stitches laterally, then hanging purl loops on the empty needles, as in full fashioned increases. Decreasing the size of the shape always involves stitch transfer, lateral and/or cross bed. When working manually, you can use all increasing and decreasing methods at once for a variety of effects.

Designs can be planned first on graph paper then knitted in either one or two colors per row. The photos show several ways the same simple diamond can be knitted in one or two colors. The fabric in the swatches is Half Milano or Long Stitch, which shows off the embossed stitches against a finely purled background.

Embossed diamond. One square = 1 stitch, 1 row in long stitch (RC2).





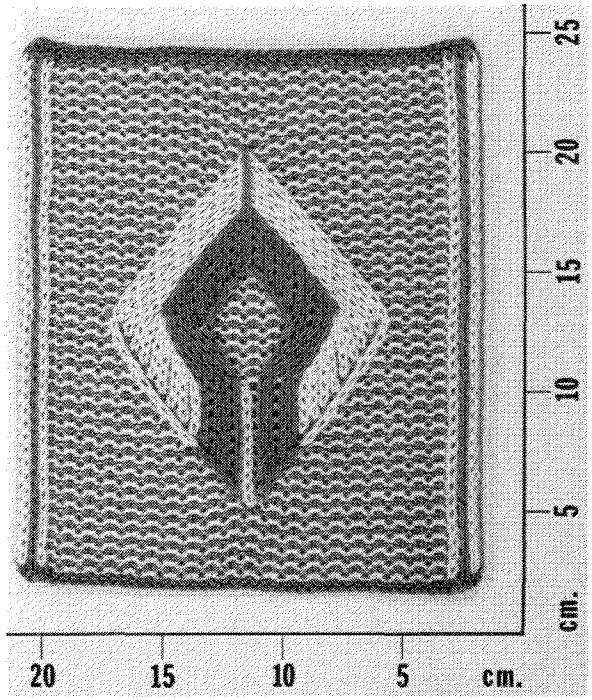
One- and two-color shapes using lateral and cross bed transfers to alter the size of the shape and to design within the shape. In all swatches, the diamond and selvedge ribs are knitted in long stitch or half Milano, which means this bed knits in one direction only while the backing knits in both directions. The graph indicates needles used in all the diamonds. The three backings can be used interchangeably. All shaping occurs every 2 rows.

Bottom of left swatch. Plated backing in stockinette, made on Superba, Brother/Knitking or Singer/Studio. To increase: put ndl in WP. It will start knitting on the next row and create an eyelet effect. To decrease: lateral transfer with one-decker tool.

Top of left swatch. Plated backing. To increase first 2 pattern rows, put ndl in WP, the same as for diamond below. After 4 rows have been knitted (3 ndls in WP), lateral transfer with one-decker tool, empty ndl in WP. To decrease: cross bed transfer to L and R.

Bottom of right swatch. Stockinette backing. To increase: hang sinker loop from the opposite bed onto the empty ndl. To decrease: lateral transfer with three-decker tool.

Top of right swatch. To increase first 2 pattern rows: hang purl loop from the opposite bed onto the empty ndl. After 4 rows have been knitted (3 ndls in WP), begin lateral transfers with a one-decker tool, hanging a purl loop from the opposite bed on the empty ndl. To decrease: lateral transfer with five-decker tool.



Two colors on 1x1 knit/tuck backing. A two-color version of the fabric at top right in the preceding photo. With ndl selection for each color, knit using the technique for two-color ribs on stockinette backing.

Embossing by Punchcard

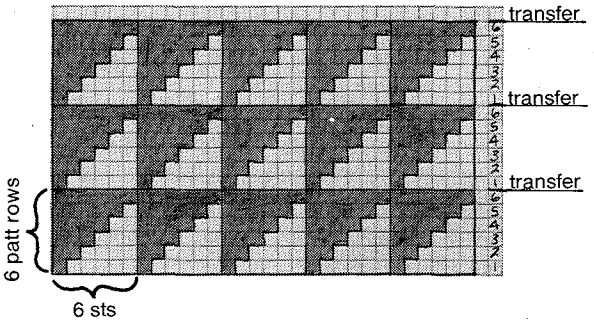
A transfer carriage is a great timesaver in this technique, because there is so much transferring of stitches. The use of a punchcard for the pattern also is a help. In the first two photographs shown below, patterning is limited to shapes which increase in size only, from bottom to top. This is a quick and easy way to make embossed patterns, even with manual selection, because adding needles is faster than taking them out, and because the transfer occurs only after a number of rows have been knitted. Good embossed designs of this kind can be found in pattern books supplied with Singer/Studio's shadow lace transfer tool, Passap's U-70, and Superba's lace carriage.

To knit these patterns, cast on the backing bed only. Then bring the needles for the pattern into action on the opposite bed, either all at once, as in a check design, or by degrees over a number of rows, as in the patterns shown. When all the pattern needles are in work and have knitted, the stitches are transferred to the backing bed, all at once, and the design begins anew. You'll see that each time a new needle is brought into action, an eyelet is formed. These patterns are generally small repeats, and can easily incorporate racking, or two colors, or some other variation. The swatches shown here were made with manual needle selection, but it would be easy to punch cards for them.

A natural extension of this technique is to transfer only selected stitches, rather than the whole bed. The ribber transfer carriages of Brother/Knitking and Singer/Studio, and Passap's U-80, are all capable of transferring selected needles in this fashion. The third swatch in this group is an example of a selective transfer pattern similar to the first two.

Another variation of this technique can be done on Passap. Many jacquard designs and punchcards can be used for irregularly shaped patterns in the embossed technique. The pushers are used for needle selection, both for stitch transfer and the outline of the shape. The photographs show examples in one, two and three colors.

Shaped embossed panels can also be knitted on Brother/Knitking by using the ribber together with the lateral transfer lace carriage (the L carr), but the effect will be very different from that produced by Passap patterns, since the transfers are lateral rather than cross bed. The outline of the shape is usually simpler, and the patterning within the shape more complex. The punchcard used for the medallion illustrated in the Lace chapter is here embossed on a stockinette and striper background.

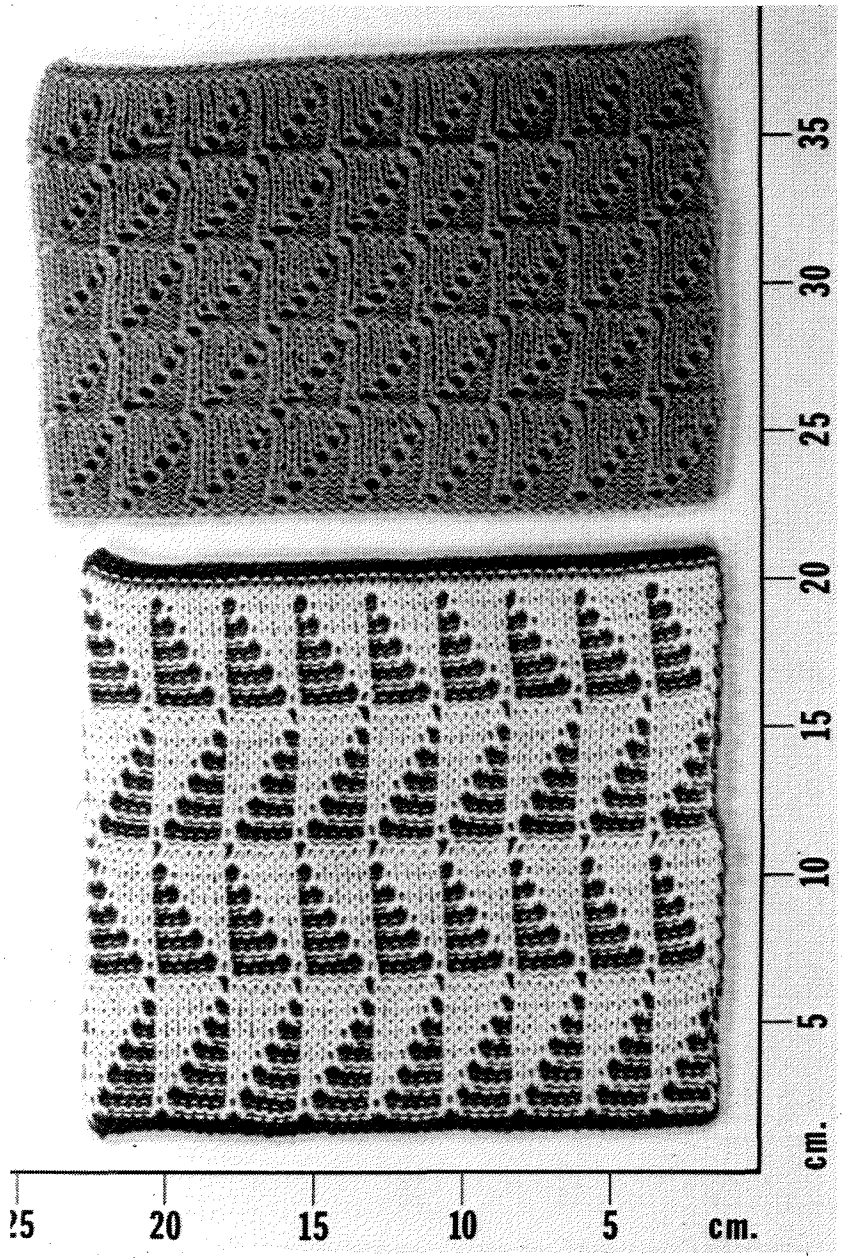


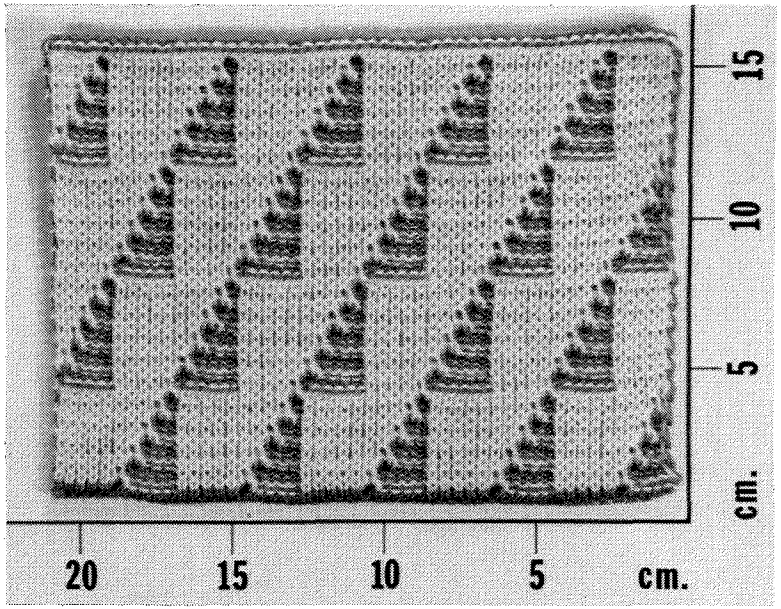
One-color embossed shape made with a punchcard or pattern ruler. Top swatch in the photo at right.

The photos at right show shapes embossed by manual selection or punchcard, for all machines. For these swatches, cast on the second bed only. The MB ndls are put in WP as needed, then put in NWP after the transfer.

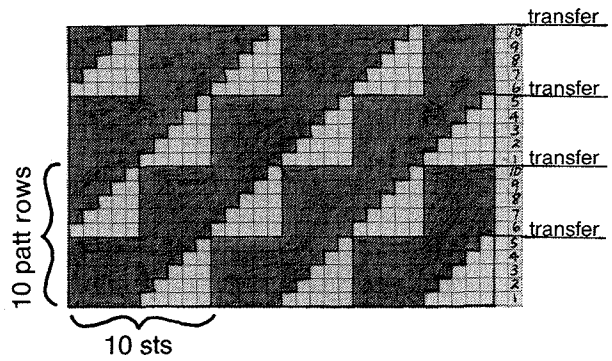
*Top. Simple, one-color shape made with punchcard or 5x1 pattern ruler. The embossed portions are in FNR, but could also be knitted in Long Stitch. Cast on the backing bed: all ndls on the opposite bed in NWP. *Put the first, then every sixth patt ndl in WP; knit 2 rows. Bring the second, then every sixth ndl to WP, knit 2 rows. Continue in this manner until all patt ndls are in WP; knit last 2 rows, and transfer all sts to the backing. All patt ndls to NWP.* Repeat.*

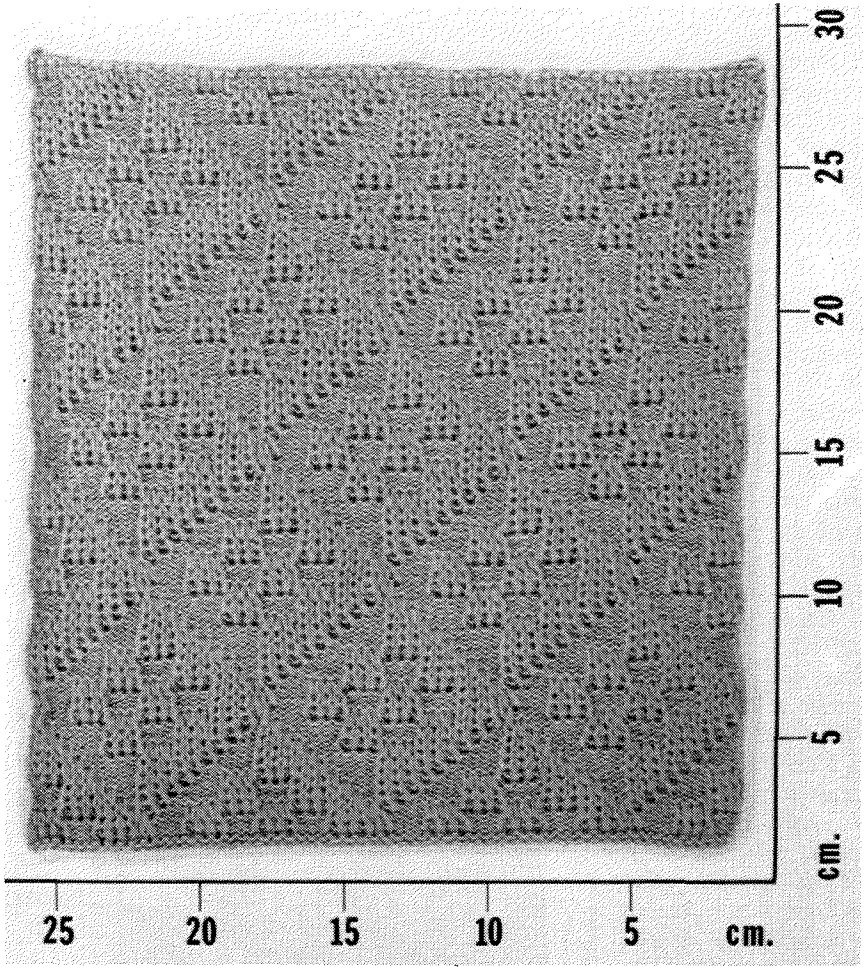
Bottom. Two-color pattern as above, but with 2 rows of color 2, knitted on the backing alone, between the 2 rows of the main color on both beds. The pattern is reversed each repeat.





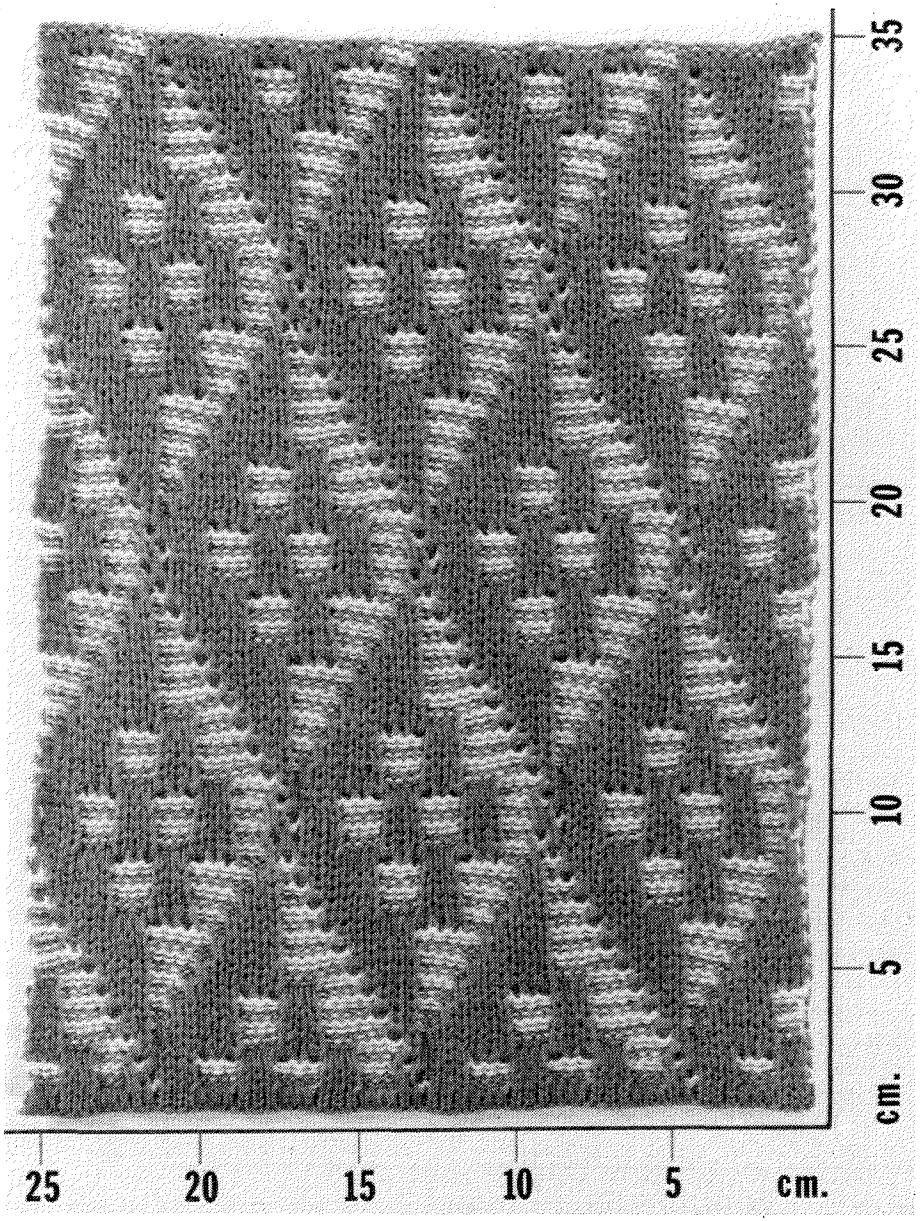
Two-color pattern knitted as the bottom swatch in the photo at left, but with selective transfer. Some sts are transferred to the backing, while others are retained on the ndls. These will continue to knit into the next repeat.



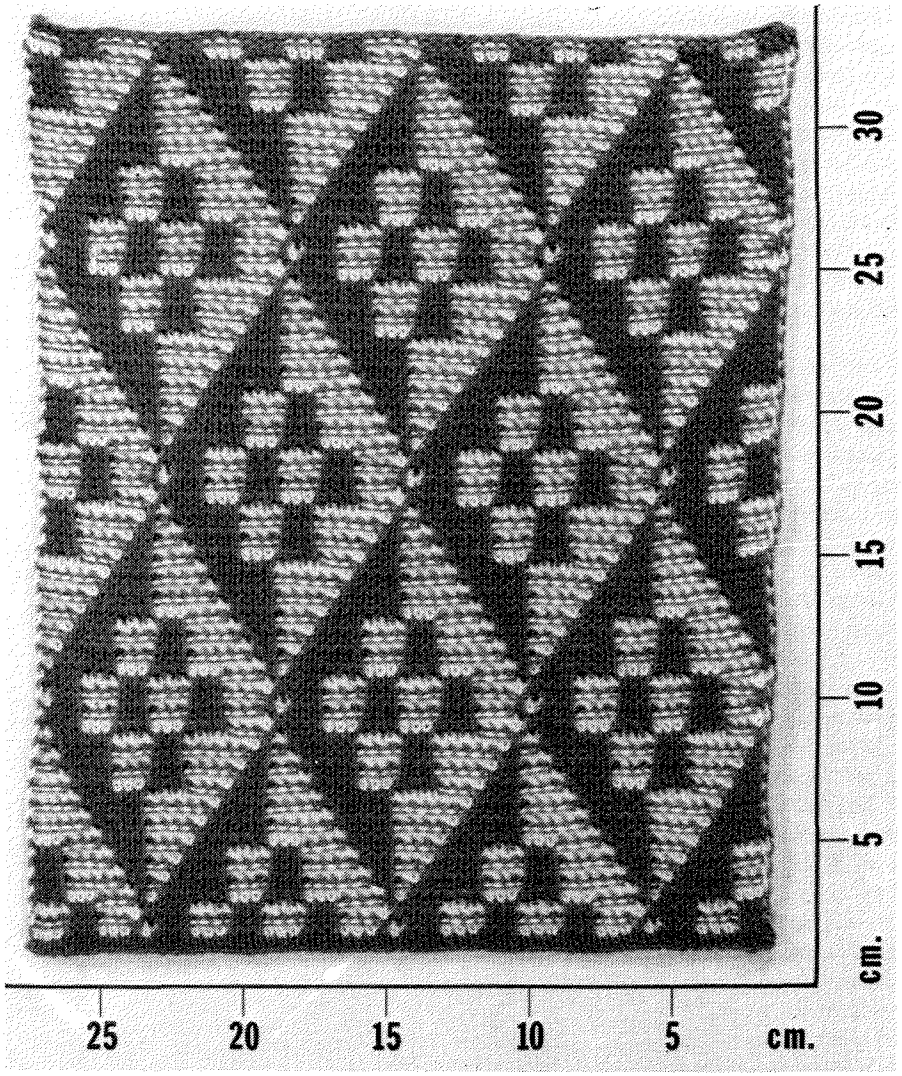


*One-color pattern knitted in long stitch, with Passap U-80. Jacquard Pattern 5, knitted according to method in instruction manual: N/HX right arrow key, Deco 2. *Knit 2 rows, transfer front to back, *U-80 set to 1 or 5. No transfers will occur on first patt row, but on subsequent rows there will be transfers.*

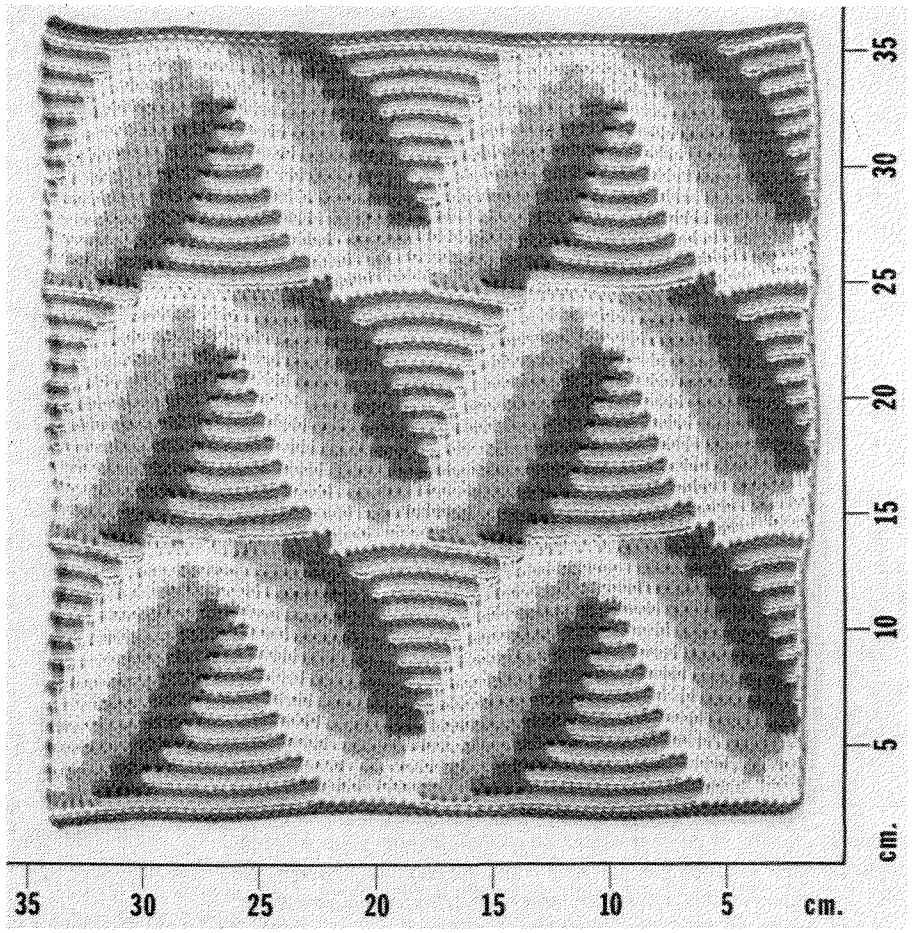
For the swatches shown on these two pages, cast on the second bed. All the MB ndls are placed in WP after casting on. The punchcard will select those needed for the pattern.



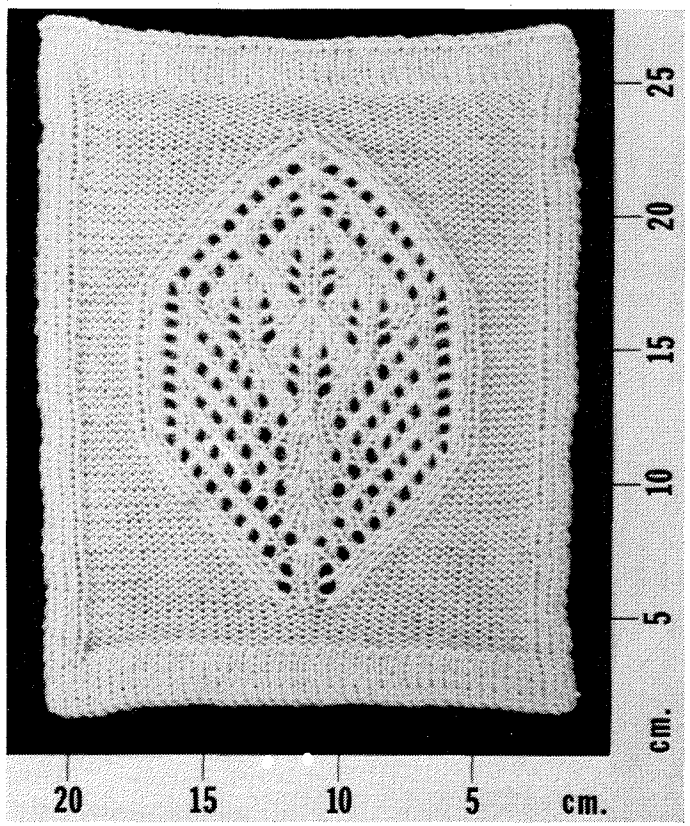
*Two-color pattern for Passap with U-80, using jacquard Pattern 5. This is the same fabric as the two-color swatches on the preceding page. *RC2 col 1 N/BX left arrow key or no arrow key; RC2 col 2 N/GX left arrow key; transfer front to back,* U-80 set to 1 or 5, Deco 4.*



*Two-color variation of pattern at left, with mock garter stitch. For Passap with U-80, using jacquard Pattern 5. N/BX, left arrow key, Deco set to 4. *RC2 each color, transfer front to back,* U-80 set to 1 or 5.*

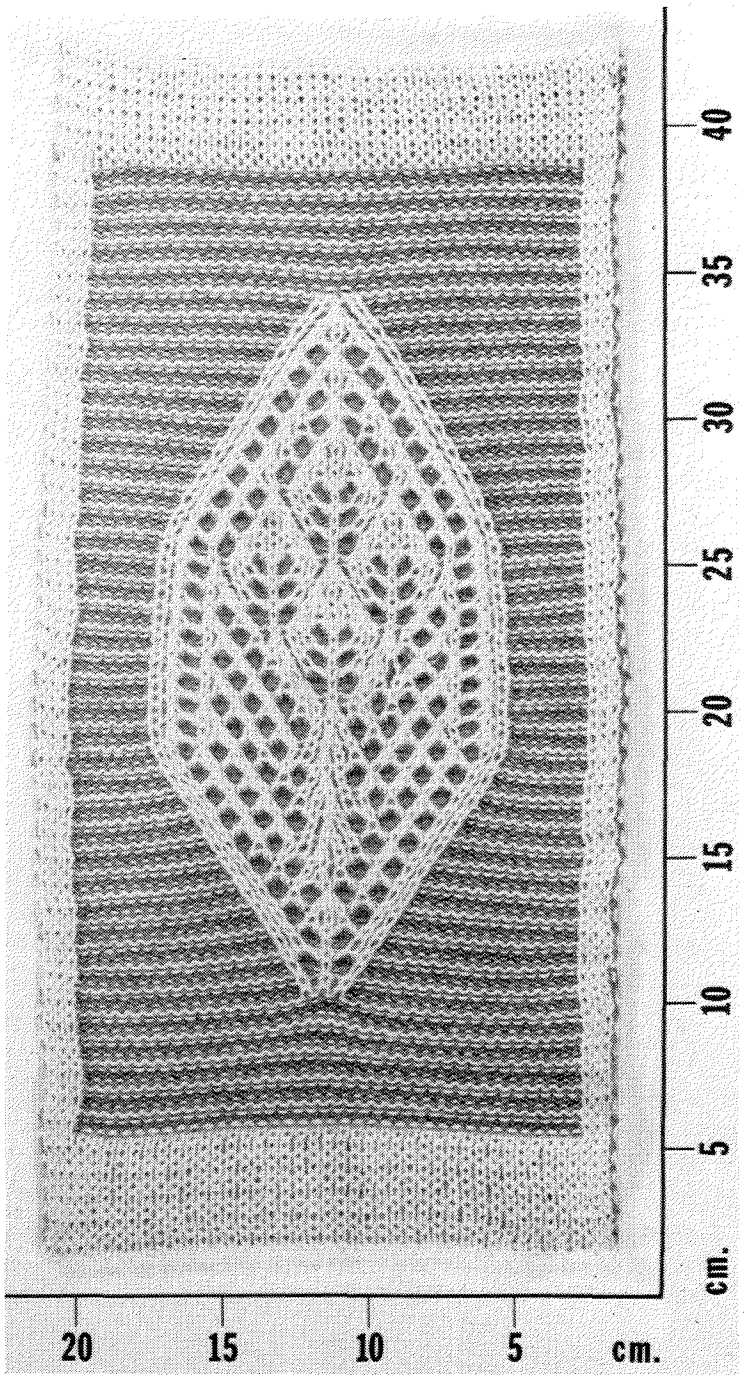


*Three-color pattern for Passap with U-80, using four-color jacquard Pattern 14. Knitted with stockinette backing, but 1x1 knit/tuck also would be suitable. N/BX no arrow key, Deco set to 2. *Knit the 3 colors with RC2 each color, and the Deco connected to the carr. Then disconnect the Deco and move L, then R to select pushers for the fourth color (which is not used), but don't knit. Instead, transfer* with U-80 1 or 5. This also can be knitted in 2 colors with three-color jacquard Pattern 13.*



Medallion pattern in one color. Preparation row and knitting sequence same as for single bed version in Lace chapter. On MB, set KC, both part buttons. On ribber, knit both directions. SS on ribber for stockinette, on MB about half that for ribber.

Brother/Knitking medallion pattern. The punchcard diagram is in the lateral transfer section of the lace chapter, as are instructions for using the L carr with the ribber. In both swatches, cast on the ribber ndls, then put MB ndls in WP. The punchcard will select the ndls both for the shape and the transfers.



Brother/Knitking medallion pattern on a two-color striper backing, using the color changer. Col 1 knits the pattern and the backing; col 2 knits the backing alone as follows: turn the card backward and reverse the positions of the K and L carriages. In each pattern row, lock the card after the last transfer with the L carr when the ndls for the K carr are selected. Push the selected ndls back twice, knitting 2 rows with col 2 (dark) on the MB alone. Knit 1 row with col 1 (light), unlock the card, knit another row, and proceed with the transfer. Cam settings and SS are the same as in the preceding pattern.

KNIT/PURL EMBOSSED PATTERNS

This fabric consists of knit and purl stitches in a stockinette fabric, and the embossed effect results from the tendency of purl stitches to recess and the knit ones to stand out, in a vertical division; or vice versa, in a horizontal division. An example of the vertical effect is an ordinary sweater welt of 1x1 or 2x1 ribbing.

If the knit and purl stitches exchange places during the knitting—that is, are transferred to opposite beds—reversible patterns can be produced, which will incorporate the qualities of both stitches in a kind of fabric popular in handknitting. The fabric can be decorated with cables, eyelets, or lace ribs, as can garter stitch. Garter stitch is a knit/purl fabric in its most compressed form; the stitches change beds every row.

Manual stitch transfer from one bed to the other with decker tools isn't difficult, but to do it quickly requires practice. Larger scale patterns that don't involve transfer every row, like the checkerboard or basket weave patterns illustrated in the photographs, could be done with manual transfer. For garter stitch, Singer/Studio's shadow lace transfer tool or a garter bar can be used with the Japanese machines. Instead of true garter stitch, you might use one of the mock garter stitches illustrated in the adjacent photo. Passap's U-80 and Superba's garter carriage simplify knitting not only of large-scale knit/purl patterns, but of small repeat patterns and garter stitch as well. Because these carriages can transfer selected stitches onto empty needles on both beds, garter stitch can be combined with knit/purl ribs, and can produce patterns as small as seed and moss stitch.

Planning knit/purl patterns on graph paper is simple. Use whatever symbols you prefer to indicate knit and purl stitches, or chart directions from hand knitting patterns and adjust them to the capabilities of your machine and transfer carriage.

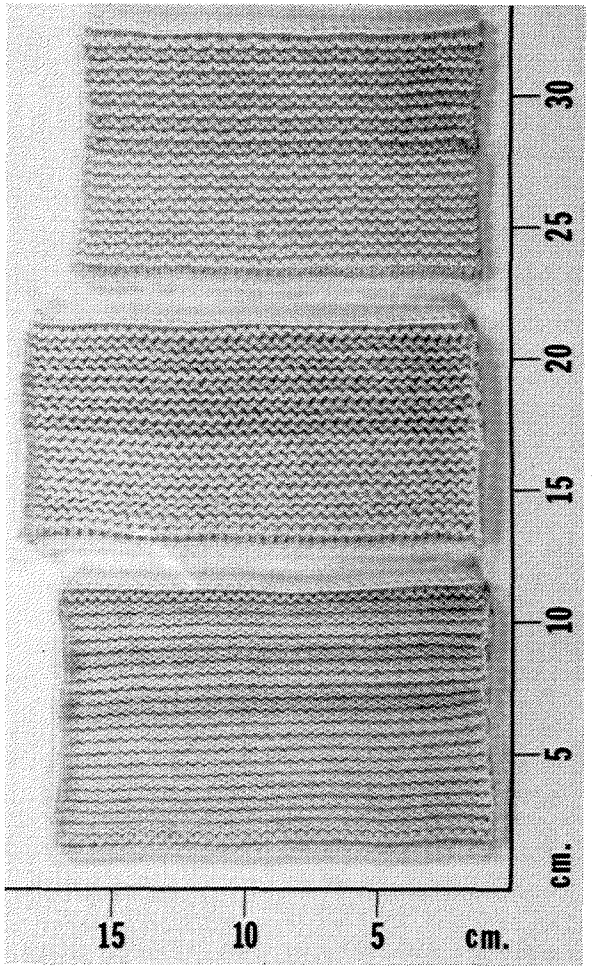
Uncomplicated knit/purl patterns with vertical and horizontal panels can be knitted easily by setting opposing groups of needles on both beds in WP/NWP and using a basic card or pusher set-up. Complex jacquard punchcard patterns with irregular groups of stitches transferred every row or two are best done on Passap with a jacquard punchcard and a U-80 coupled with a Jac 40 and an identical card, as needle selection must occur on both beds. Soon, the new Brother/Knitking garter carriage will also allow easy knitting of these patterns on the Brother/Knitking machines.

Garter stitch and mock garter stitch, for all machines. Beds, cam settings, and carriage starting side can be reversed if desired. Check the capability of your transfer carr for making stitch transfers quickly and easily (see Cross Bed Transfers in Reference Chapter 5).

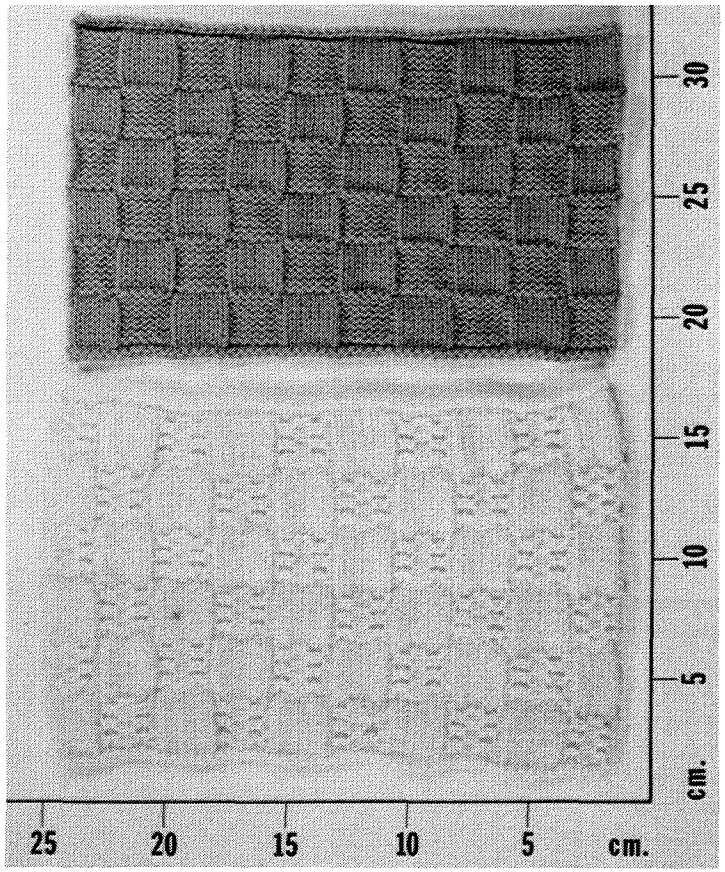
*Top. Garter stitch. Cast on front bed, carr R. Beds full pitch or transfer position. Stitch size on both carriages for stockinette. Set cams for tubular, with front bed sts knitting first. *Knit one row, transfer sts to back bed, knit one row, transfer sts to front bed.* Color change every RC2 with carr R.*

*Center. Mock garter stitch, made by cross bed transfer technique. Cast on back bed; beds half pitch, carr R. Set back carr to knit both L and R; front carr to knit R-L, slip L-R. SS on back bed for stockinette, on front bed about half that of back bed. *Knit one row, transfer all sts to back bed, knit one row on back bed alone.* It is best to alternate L and R transfers to avoid bias. Change color every RC2.*

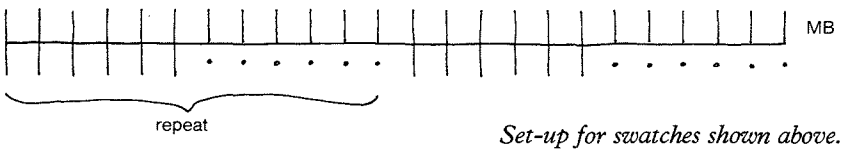
*Bottom. Mock garter stitch, made by the drop stitch technique. Cast on back bed; beds half pitch, carr R. Set cams as for center swatch. SS on back bed a little small for stockinette; on front bed, as small as possible. *Knit 2 rows, drop the front bed sts with the front carr alone.* Change color every RC4 with carr R.*



Garter stitch and mock garter stitch.

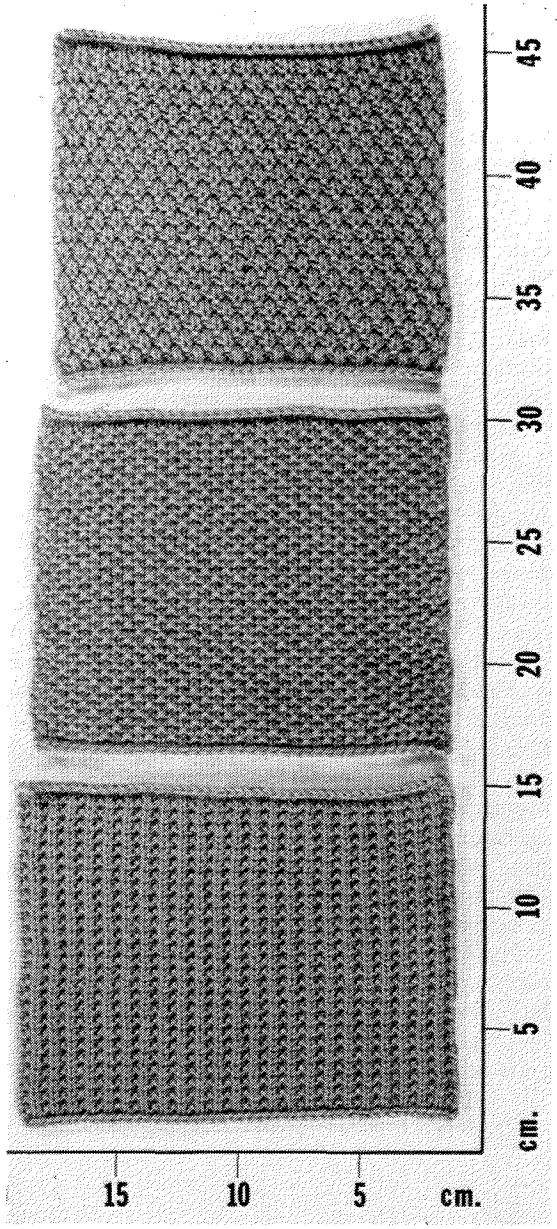


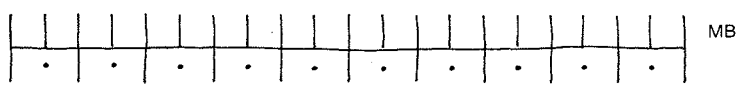
Knit/purl patterns with simple needle selection on the MB, for all machines.
*Top. 6x6 check. Rack beds to one end before setting up. Cast on MB. Set MB cams to slip; second bed cams to knit. *Transfer groups of 6 sts to the ndls on the second bed. With 6x6 pattern ruler, pushers, or 6x6 punchard for the MB, select to patt pos only those ndls on MB which have sts, every row. Knit a total of 8 rows with this selection. Transfer the second bed sts to MB, rack 6 ndls.* Repeat.*
*Bottom. Variation with tuck stitch, for all machines except Passap. Knitted as swatch above with this addition: *on the MB, put one or two ndls in each group in HP. Knit 3 rows with these ndls in HP, then knit one row across all ndls.* In the swatch shown, this sequence was done 3 times in each check.*



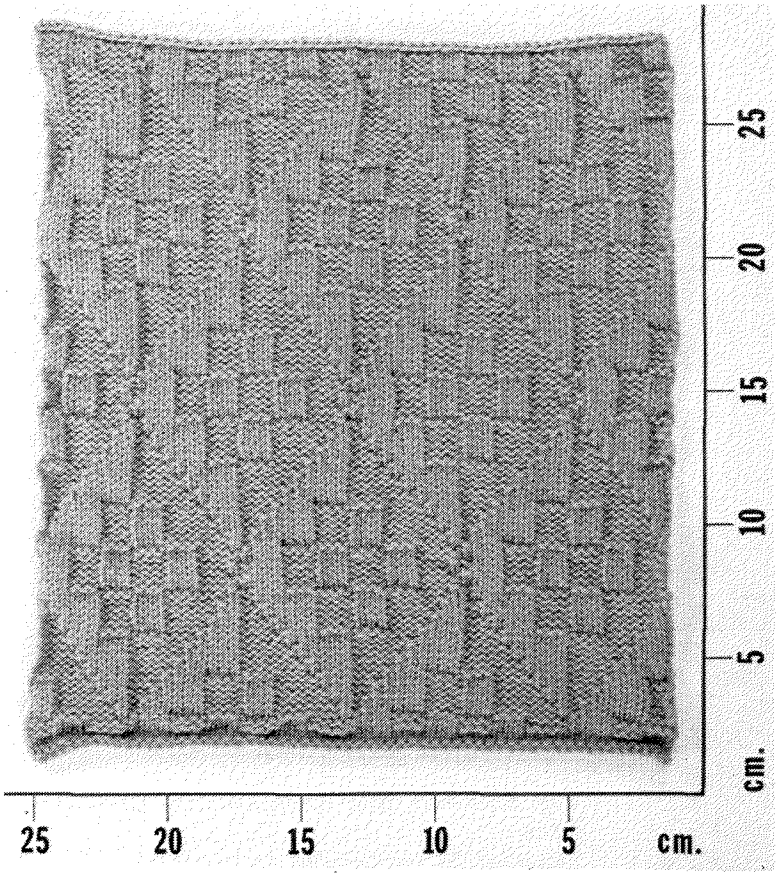
Set-up for swatches shown above.

*Top. Moss stitch. Cast on MB; set MB cams to slip, second bed cams to knit. *Transfer every other st to ndls on the second bed. Using 1x1 pattern ruler, pushers, or punchcard, select ndls with sts on the MB to patt pos, knit 2 rows (you will be knitting 2 rows in 1x1 rib). Transfer the second bed sts to MB, rack one ndl.* Repeat.*
Center. Seed stitch variation. Knit as moss stitch, but knit only one row between transfers.
*Bottom. Garter stitch rib. Use moss stitch needle set-up. Cast on MB, carr L. Set cams for tubular so MB knits L-R, second bed R-L. *Knit one row (MB knits). Transfer sts to second bed (1x1 rib). Using pattern ruler, pushers, or punchcard, select ndls with sts on MB to knit, knit one row (both beds knit 1x1 rib). Transfer sts to MB.* Repeat.*





Set-up for swatches shown above.



*Knit/purl, or damask, pattern made on Passap with U-80 and Jac 40, using jacquard Pattern 5. This is a reversible fabric. Set both carr to BX with left arrow keys. On back bed, place pushers in WP. Use 2 identical punchcards, one for the Deco, and one for the Jac 40, inserted backward in Jac. Deco at 2, uncoupled; U-80 1 or 5. Cast on either bed. *Move Deco alone L-R-L to select pushers for the front bed. Select from WP to RP with the Jac on the back bed. Transfer back to front, and front to back. Knit 2 rows.* Repeat.*

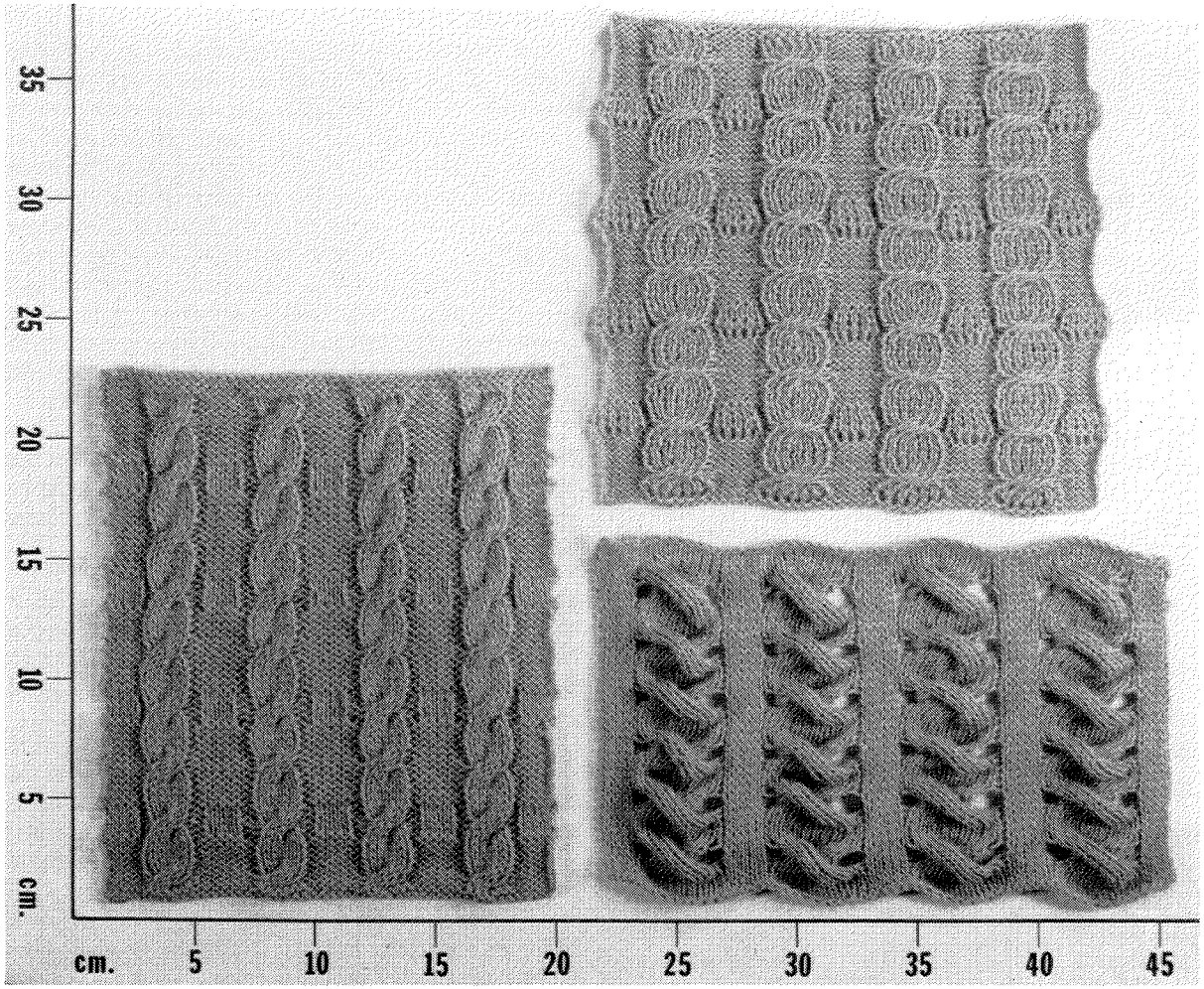
CABLES

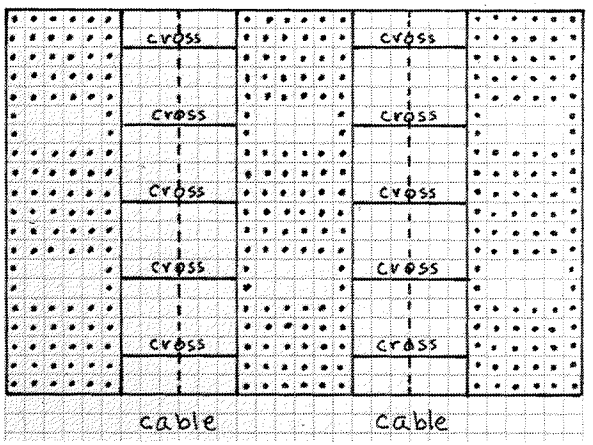
No chapter on embossing would be complete without a discussion about making cables, probably the best known form of the embossed patterns. A tremendous number of cable variations are possible, yet all are made in the same general way: the stitches on adjacent groups of needles exchange places by being crossed over each other. The three ways of making a single (or crossed) cable presented here are basic techniques that can be varied to suit your pattern and yarn. As you knit these swatches, remember that cable crossing by any method requires some practice, so don't be discouraged if you lose all your stitches on your first try.

Of the three methods for making cables, the first two require some means of loosening the stitches on the row where the crossing occurs so the crossing can be made without breaking the yarn or the needles. There are two ways of doing this, described below.

Double-knit cable on stockinette fabric. This is the simplest, most direct way to cross a cable and can be used in the knit/purl cable below as well. Though not complicated, it does take some time. It is a good method for a beginner.

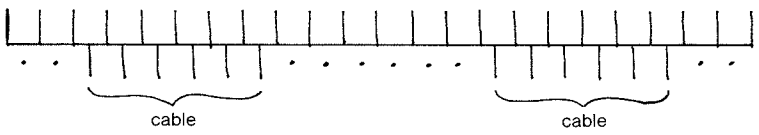
1. Cast on and knit some rows in the set-up given.
2. Knit the crossing row with the stitch size on the cable bed set one or two sizes larger. (Any rib stitches other than cables will have large stitches on this row.)
3. With a three-decker tool in each hand, remove each group of three stitches from the needles.
4. Cross the tools over each other, either left over right, or right over left, stretching the stitches, then replace the stitches on the needles.
5. Knit about eight rows, then repeat from step 2.



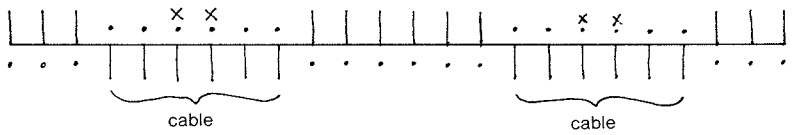


Cable diagram. Blank square = knit stitch; dotted square = purl stitch. Each square = 1 stitch and 2 rows.

Top. Six-needle cable: double-knit cable on stockinette fabric.
Lower left. Six-needle cable: stockinette knit/purl cable. Both in this swatch and the one above, an embossed square pattern was added between the cables. See the charted cable diagram.
Lower right. Short row cable.



Set-up for double-knit cable on stockinette fabric.



Set-up for stockinette knit/purl cable.

Stockinette knit/purl cable. The garter bar (for Brother/Knitking and Singer/Studio) and multi-decker stitch holder (for Passap and Superba) provide an efficient way to cross several cables, or a whole bed of cables, at the same time. This method, too, takes practice.

1. On the crossing row, place the beds in half pitch; place the two needles marked x in WP. Knit the row, then drop the two stitches and put the needles back in NWP and the beds back to full pitch. This will loosen the stitches for the crossing. If you don't have a garter bar or stitch holder, at this point you can proceed with steps 3 to 5 in the double-knit cable above.
2. Lower the second bed slightly, if necessary. This is going to tighten the stitches somewhat.
3. Move the three left needles of each group out so the stitches fall behind the latches; use a pattern ruler if you like. Transfer these stitches onto a garter bar or multi-decker stitch holder.
4. Move the garter bar six needles to the right, push out the three right needles of each group and transfer them onto the garter bar as before. The two groups will be crossed on the garter bar.
5. Move three needles to the left (in position in front of the original needles), and transfer all stitches back onto the needles at once.

The racked crossing. The crossing of stockinette knit/purl cables can also be facilitated by racking. This method is useful for crossing several cables, or a whole bed of cables, at the same time, either manually or with a cross bed transfer tool or carriage. Before starting to knit the fabric, be sure the racking lever is at the center. Needles for the crossing row are as in the method above. The set-up and knitting are the same as for the garter bar method above. After knitting a row, drop the x stitches as indicated in the diagram.

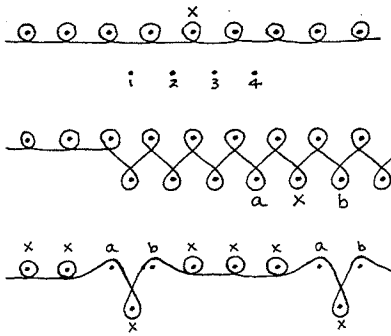
1. Rack three needles to the left on Passap, to the right on other machines, then transfer three left stitches to empty needles on the opposite bed.
2. Rack six needles to the right on Passap, to the left on other machines. Then transfer three right stitches to empty needles on the opposite bed. Stitches are now crossed on the opposite bed.
3. Rack three needles to the left on Passap, to the right on other machines. Then transfer all six stitches back to original needles.

Short row cable. This cable is most easily made in stockinette fabric with no purl stitches. It is a sharply raised cable in high relief, and is particularly striking when knitted with heavier yarn. One-half of each cable is given extra rows of knitting before it is crossed. Only one cable at a time can be knitted across the bed. As this is a ten-needle cable, the crossing is done with two five-decker tools. Set up groups of ten stitches, with five stitches between groups.

1. On the side opposite the carriage, put all needles beyond the first cable in HP. Knit one row, then put all the remaining needles in HP except the ten stitches of the first cable panel.
2. Knit three rows across these ten needles, then put the group of five needles opposite the carriage into HP.
3. Knit nine (or any odd number) rows on the remaining five needles, using one of the decker tools to hold the stitches down.
4. Cross these stitches with the adjacent five stitches of the cable panel, which are in HP, by crossing the short row half of the cable toward the knit side of the fabric, and the other five toward the purl side of the fabric. Knit one row across these ten stitches.
5. Now put all needles between this cable, plus the next group of cable stitches, in position to knit. Knit one row. Put the ten stitches of the first cable, plus those between the first and second cable, in HP. Repeat from step 2.
6. When all panels have been knitted, knit five rows across all needles and begin short rows again.

POPCORNS

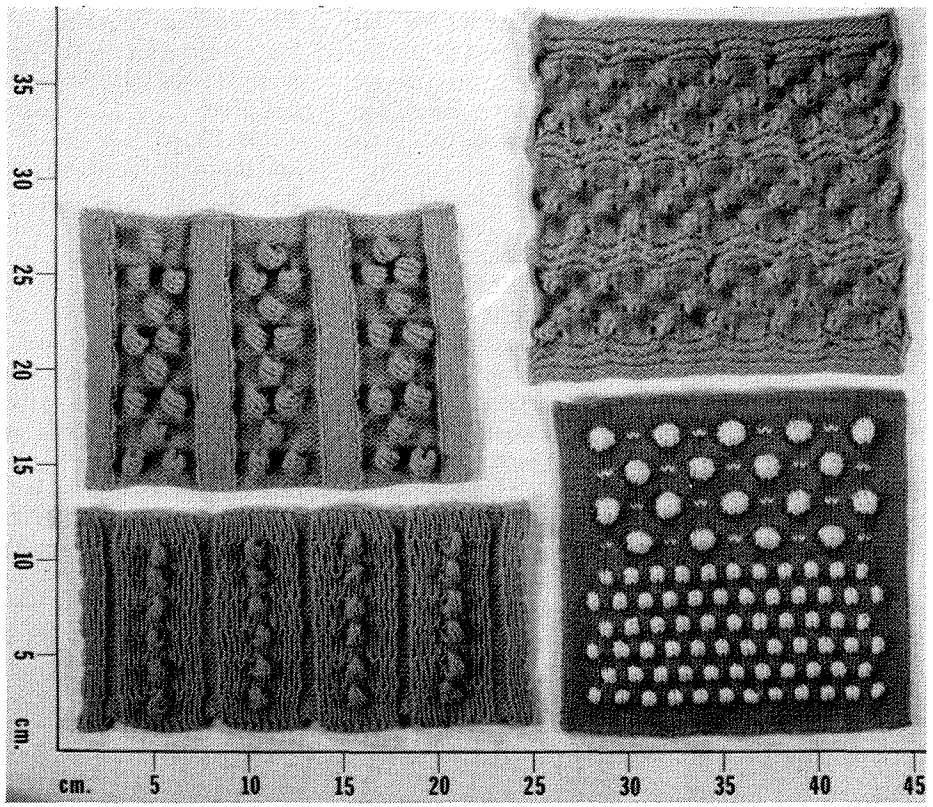
Popcorns, or bobbles, are another well known form of embossing. There are two basic methods for making them: they can be very narrow three- or four-needle pin tucks, or one- or two-needle nopps. The pin tuck popcorns are made one at a time across the bed. The nopps can be made singly, on all machines except Passap, or as an all-over pattern on all machines.



Pin tuck popcorns.

Popcorns embossed on rib fabric.

Nopped popcorns.



Top left. Pin tuck popcorns embossed on stockinette fabric (four-needle popcorns). Cast on for stockinette and knit some rows. On the side opposite the carriage, put all ndls up to the x *needle in HP. Knit one row; put remaining ndls in HP. The* x *ndl remains in WP throughout. Place ndls 2 and 3 in WP on the opposite bed, and knit one row, then place ndls 1 and 4 in WP, one at a time, on the side opposite the carr, knitting one row between. Knit as many rows as necessary for popcorn size (usually 4 to 6). Transfer sts 1 and 4 to ndls 2 and 3. Put ndls 1 and 4 in NWP. Knit one row, transfer sts 2 and 3 to* x. *Put ndls 2 and 3 in NWP. Knit one row on remaining* x *ndl. Move the ndls in the area up to the next popcorn in position to knit. Knit one row, put these ndls back into HP, and proceed with the next popcorn. A hint: Brother/Knitking and Singer/Studio ribber edge weight wire hangers are perfect for weighting individual popcorns. After the fabric is removed from the machine, the popcorns can be pushed through to the other side of the fabric if you want them on the knit side.*

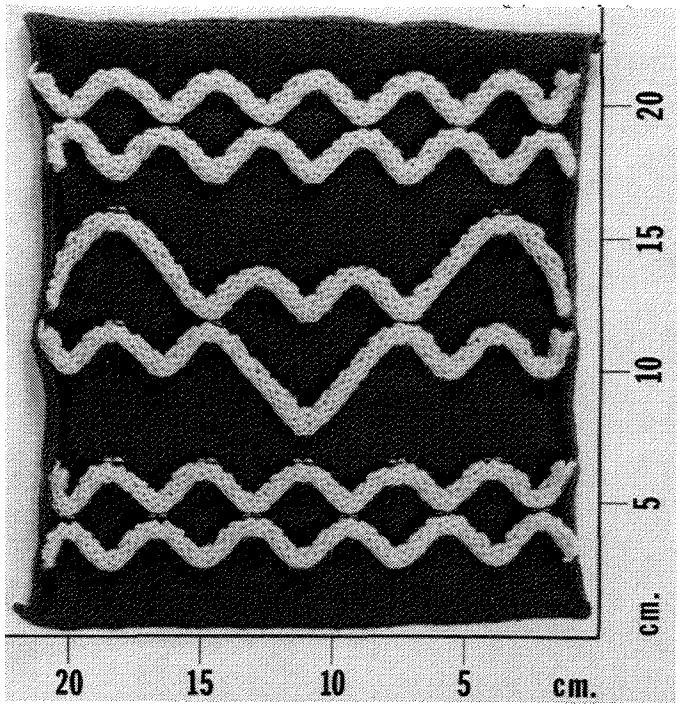
Bottom left. Popcorns embossed on rib fabric (three-needle popcorns). Unlike the single bed popcorns above, these must be knitted on the side of the fabric where they are to show. All ndls on either side of x *on both beds are put in HP by the procedure given above. Increase the SS by one or two numbers on the bed that knits the popcorns. Knit 3 rows on the* x *ndl alone, then put ndls* a *and* b *in WP, on the side opposite the carr, with one knitted row between. Knit as many rows as you want for the popcorn. Transfer sts* a *and* b *to the* x *ndl and hang a purl loop from the adjacent ndls on the back bed on the empty* a *and* b *ndls. Knit 2 rows on the* x *ndl alone, reduce the SS to normal, and go on to the next popcorn as described above.*

Top right. One-needle nopped popcorns, embossed on the purl side of stockinette fabric as an all-over pattern. All popcorns across the row are knitted simultaneously. Cast on the MB only. Ndls a *and* b *must tuck, while* x *ndls on both beds must knit. Use a pattern ruler, punchcard, or pushers to select ndls, set MB cam to tuck and second bed cam to knit. Place* x *ndls on the second bed in WP, set cams, and if a punchcard is used, lock it so the same ndls will knit/tuck continuously. Knit as many rows as desired for the nopps (5 or 7). Knit one row plain on both beds to knit off the tuck loops. Transfer the nopp sts on the second bed to adjacent ndls on the MB. Knit several stockinette rows before the next nopp row, or change the ndl selection to alternate with the previous selection, and start the next nopp rows immediately, as shown in the photo.*

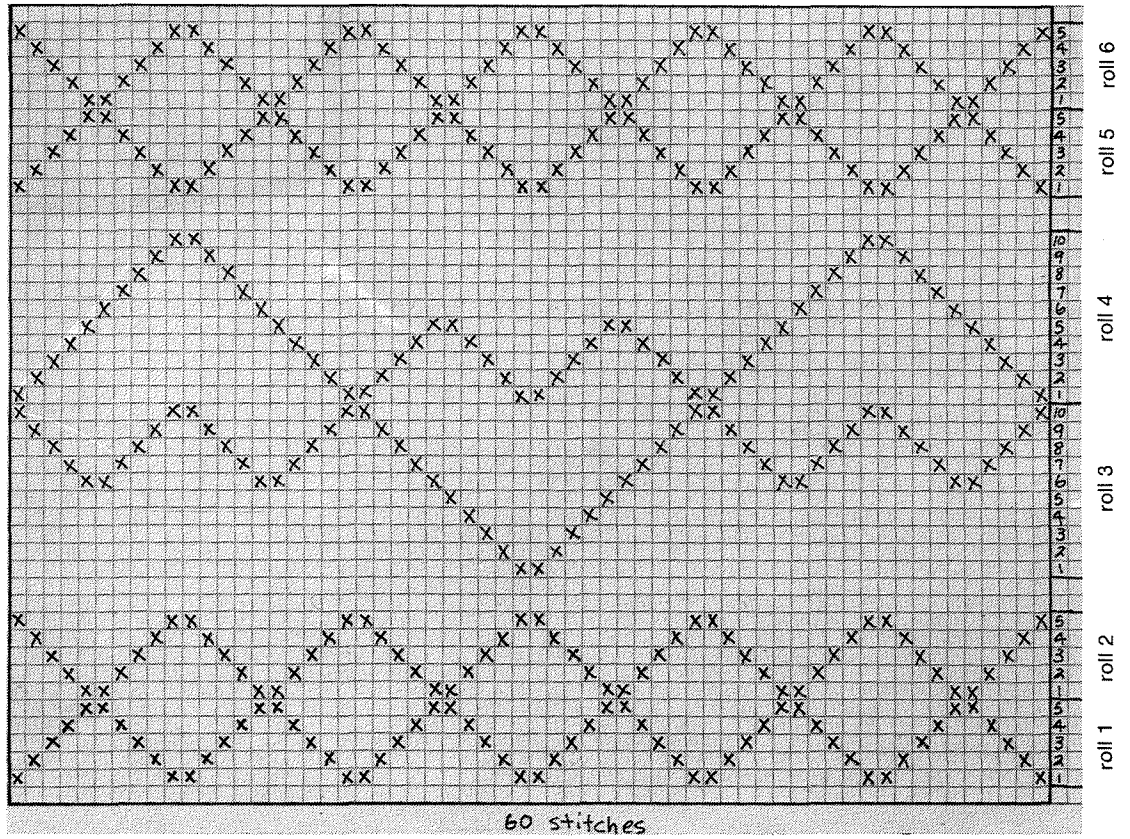
Bottom right. Two-needle nopped popcorns in two colors, made on one bed and embossed on the knit side of stockinette fabric.

*Bottom of swatch. For Superba, Brother/Knitking, and Singer/Studio. Knit 4 rows in col 1 (dark) over all ndls. *Move every third and fourth needle into HP (2x2), set carr to keep ndls in HP. Knit 4 rows with col 2. Set carr to knit ndls back. Change to col 1, knit 4 stockinette rows.* If you want the popcorn to be in higher relief, pick up the center loop from the start of the popcorn and hang it on one of the ndls above it, just prior to knitting the 4 rows in col 1.*

*Top of swatch. Four-needle popcorns like those at bottom, but knitted manually from a separate ball of yarn. For all machines. *Knit 6 rows with col 1 over all ndls. Manually knit col 2 for 5 rows back and forth over the first popcorn group of 4 ndls. Move to the next group of 4 ndls and continue.* If there is a long space between groups, knit one or two ndls once in between, as shown, to prevent a long float.*



A roll fabric.



Stitch transfer chart for roll pattern. X = stitch on roll to be transferred to backing. Knit 2 rows on backing between the transfer sequences on each pattern row.

EMBOSSING BY CASTING ON STITCHES

Here, the main fabric is knitted in stockinette on the back bed of the machine. Patterning is achieved by periodically casting on some stitches on the front bed, then knitting some rows on each bed separately. The new stitches on the front bed are then transferred to the main fabric on the back bed, either all at once or selectively over the next few rows. Then more stitches are cast on the front bed and the process is repeated.

As the photos show, the patterning takes advantage of the fact that the bottom selvedge of a stockinette fabric will roll up. To keep the cast-on edge loose and stretchy, the every-other-needle method is used. Bring EON to WP, knit one row; then bring the alternate needles to WP, knit one row over all, and continue knitting. In some fabrics on some machines, a cast-on comb will be needed (the flat kind with a wire); in others, small claw weights will suffice. In still others, these may not be necessary at all. Since many knitters never have had to cast on in this fashion on the front bed, especially with knitting already in progress on the back bed, practice is suggested.

Roll pattern

The main fabric (dark color) is knitted on the back bed in stockinette or in a simple tuck or slip pattern. Work stops on the back bed while the roll (light) is created on the front bed by casting on with a comb as many needles as there are on the back bed, then knitting six to eight rows in stockinette at a stitch size about one number larger than for the main fabric. A few of the roll stitches are then transferred to the main fabric. Two rows are knitted on the main fabric, then some more of the roll stitches are transferred. Two more rows are knitted on the main fabric and the process is repeated until all the roll stitches have been transferred. Work then stops while the cast on comb is removed and a new roll is knitted on the front bed. The illustrated swatch has a pattern of six rolls, and the accompanying chart shows how the stitches were transferred every two rows. On Passap, the U-80 and pushers can be used to select for transfer; on Japanese machines, the ribber transfer carriages can be used, or transfer can be done manually. A great many variations are possible with this kind of patterning. Different colored rolls can be knitted, or short pieces of rolls can be spaced across the bed. Other kinds of trims might be substituted for the rolls, such as braids and ruffles knitted separately.

Shell pattern

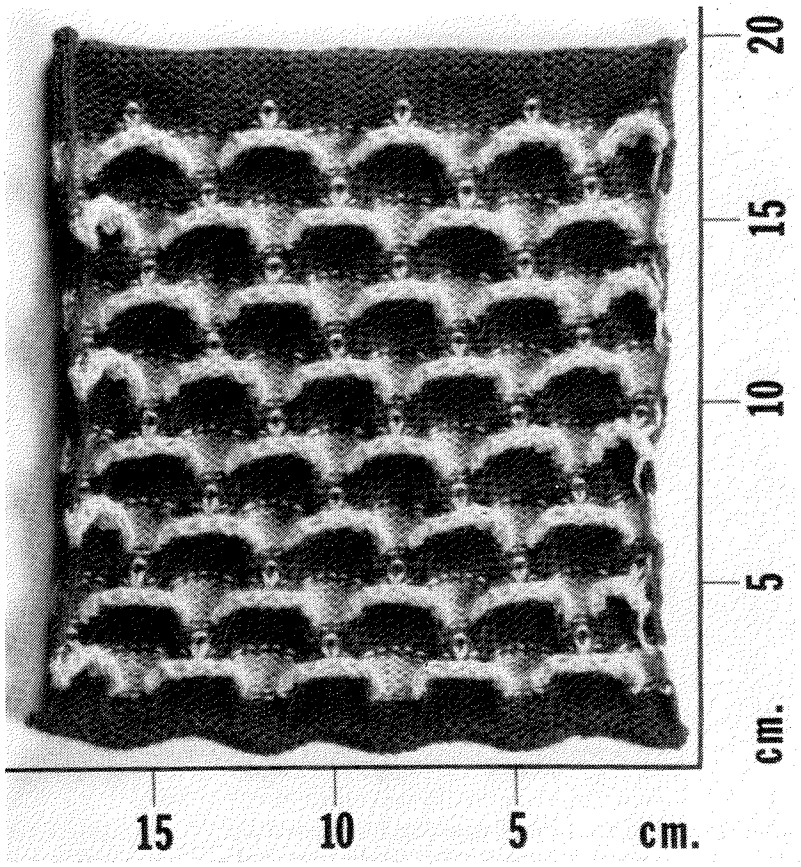
This pattern is based on the common checkerboard technique which is useful in so many different kinds of drop stitch and transfer fabrics. All needles are in WP on the back bed, and alternating groups in WP/NWP on the front bed. When one pattern sequence is finished, the beds are racked to the alternate position and the sequence is repeated. In this pattern, the embossed shells are created on the working needles of the front bed and their stitches are gradually transferred to the backing over the next several backing rows.

To knit the shell pattern, rack beds to one end before setting up. Cast on the back bed with col 1 (dark) and knit some rows.

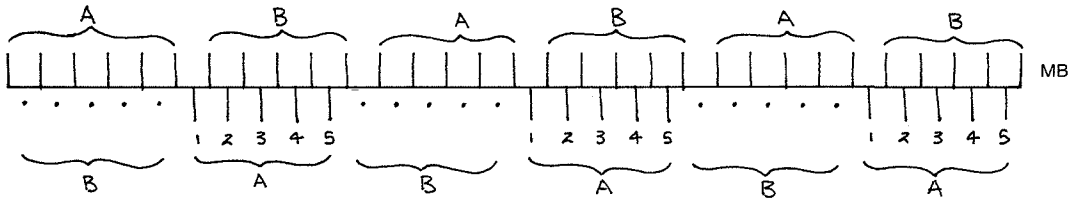
*Step 1. Set the BB carr for slip, FB carr for knit. With pushers, punchcard, or pattern ruler, bring the 5 ndls on the BB which face the 5 ndls in NWP on the FB to patt pos (the A ndls on BB), and knit 1 row with col 2 (light). There will be 5 knit/5 purl sts. Repeat this for 6 rows. The first 2 of these 6 rows will be cast on rows for the empty ndls in WP on the front bed.

Step 2. Now change to col 1 and set the BB carr for knit and the FB carr for slip. Transfer sts 1 and 5, knit 2 rows on the BB alone with col 1, transfer sts 2 and 4, knit 2 more rows, transfer at 3, knit 2 more rows.

Step 3. Rack beds 5 spaces.* Repeat the sequence with the B ndls.



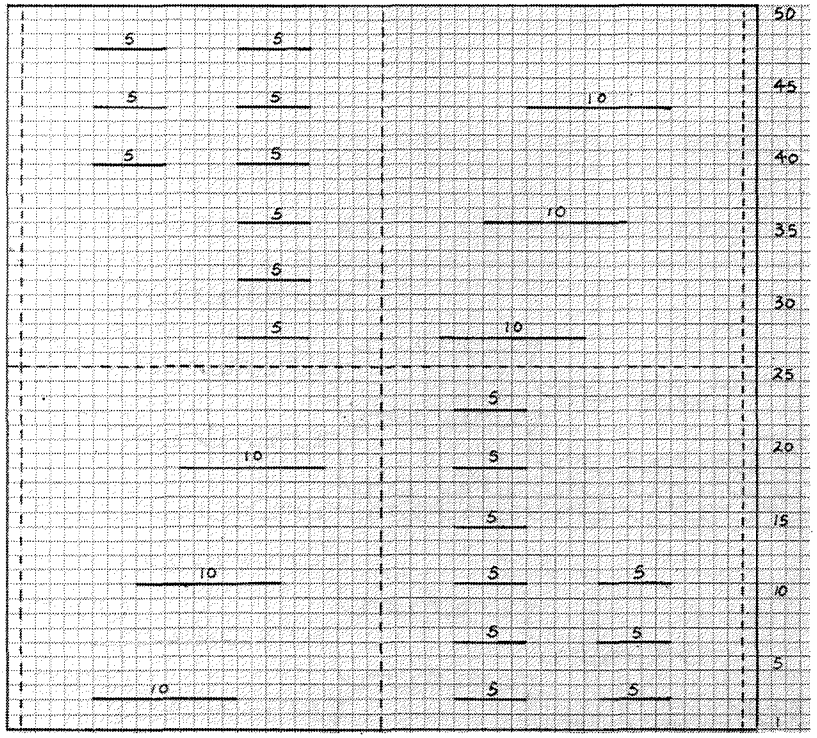
Shell fabric.



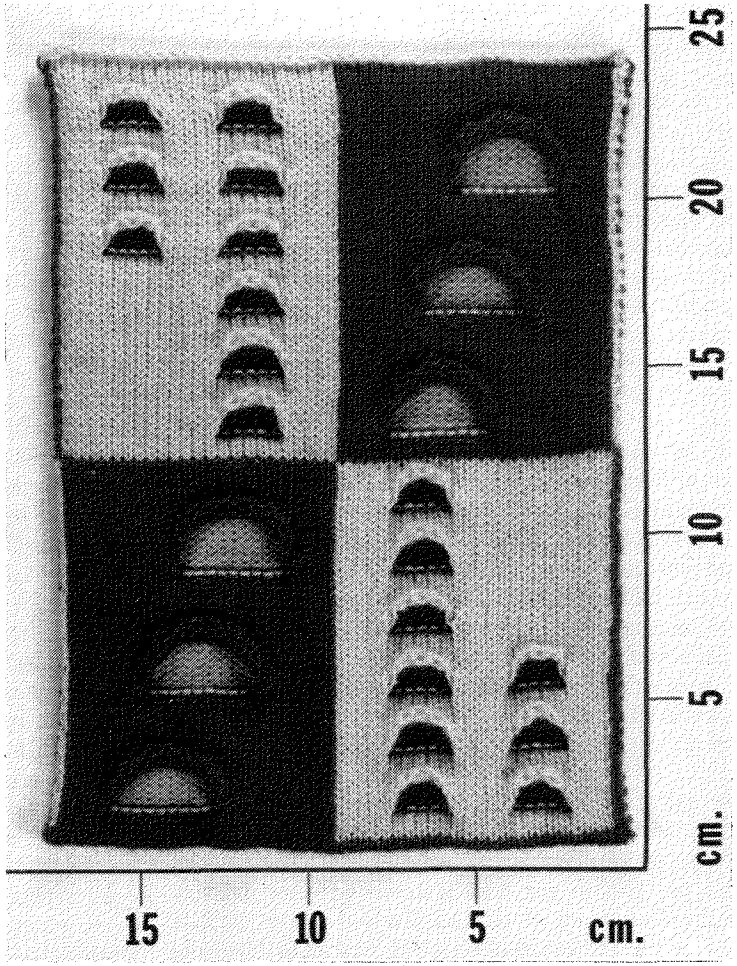
Set-up for shell fabric.

Window pattern

These "windows" can be incorporated into any fabric or portion of fabric based on tubular knitting, such as plain tubular stockinette, eight-lock (shown in the photograph), quilting, or flat or raised blister. The principle is similar to that for knitting buttonholes; some of the stitches on one of the beds are transferred to the opposite bed (or they can be bound off if you don't want the two fabrics joined), then the empty needles are immediately cast on again over the next two rows. The diagram shows placement of the stitch transfer for each window in the swatch; it can be used for any of the above-mentioned fabrics. Since the fabric on the opposite bed shows through the windows, stripes, tuck stitches, or popcorns in the windows could be incorporated for added embellishment. Windows can be made in any type of stockinette fabric (other than tubular) to produce exceedingly large eyelets.

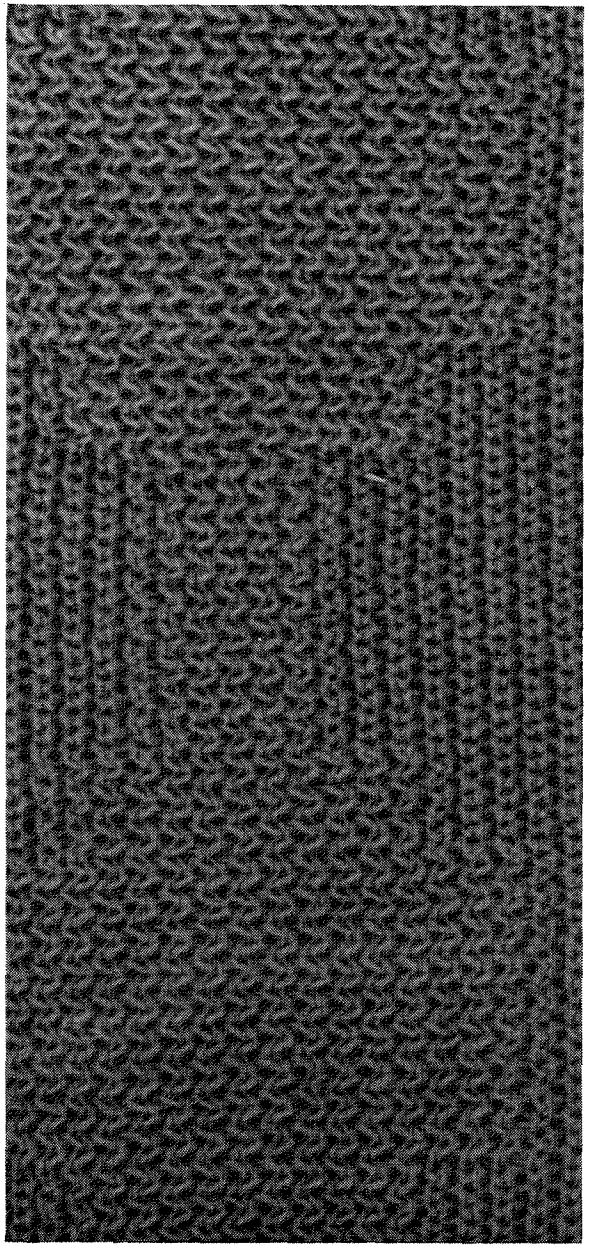


Window pattern in eight-lock. One square = 1 stitch, 2 rows (RC4).



Window pattern.

CHAPTER 13
The Principles of Racking



We've already talked about racking as a patterning aid in lace, embossing, plating, jacquard and ripple knitting. Now we want to discuss its underlying principles and eliminate, we hope, the confusion which for many knitters surrounds racking and racked fabrics, particularly those fabrics based on full and half fisherman's rib.

Racking is a double bed technique whereby one bed is moved laterally by means of a racking handle located under the front bed at the left side. When stitches are knitted on both beds, as in full needle rib, this sideways movement causes the stitches opposite each other on the two beds to be displaced in their consecutive order of knitting, and to be pulled or slanted diagonally between the beds. Because the needles will then have a new consecutive order of knitting, this slant can be permanently fixed into the fabric if a new row of stitches is knitted while the beds are in the racked position. The beds can then be racked again, either in the same or the opposite direction, to slant the next row of stitches. When the fabric comes off the machine, the effect of the racking can be seen in the diagonal, rather than the normal, vertical alignment of the stitches.

Our discussion of racking will be limited to plain and patterned fabrics with all-over designs knitted in full and half fisherman's rib. Though they can also be done in plain knitting on both beds, tuck rows added to plain knitting on one or both beds dramatizes the effect of racking and greatly extends the range of design variations. Adding tuck rows also will condense the fabric vertically, separate the stitches horizontally, and thus emphasize the whole effect of racking in the pattern.

The swatches illustrating the basic principles of racking are knitted both in full and half fisherman's rib. To show some patterning possibilities, other swatches have more tuck rows added to these two basic fabrics, or have needles left out of work, or use tuck/knit combinations on the same bed.

There are four principles to observe when designing racked fabrics, especially those incorporating tuck stitches. Once you understand the principles, and have practice in making the swatches, you should be able to control the effects of racking and create your own fabrics and patterns. The same principles apply to all machines, no matter which bed is the main bed and which bed does the racking. The stitch formation diagrams will help you see how to apply these principles.

THE BASIC PRINCIPLES OF RACKING

1. Racking usually occurs after a *tuck row* on one of the beds has been knitted. In half fisherman's rib, where the main bed alternates knit and tuck rows and the second bed always knits, racking usually occurs after the main bed tucks, every two rows. In full fisherman's rib, where both beds alternate knit and tuck rows, racking can occur after every row, since one or the other bed is always tucking; or it can occur after two rows.

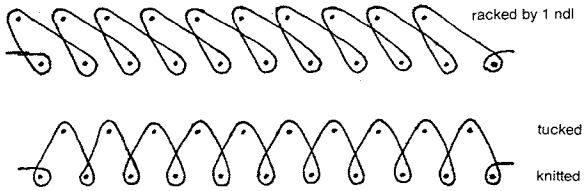
2. The effect of racking—the slanting of the stitches—will show on the fabric face knitted on the bed *opposite* the tuck row which was racked in principle 1 above. In half fisherman's rib, racked every two rows, the slanted stitches will appear in the plain knit stitches of the second bed. In full fisherman's rib, if racking occurs after every row, the slanted stitches will appear on both sides of the fabric. If racking occurs after every two rows, the slanted stitches will appear on only one side of the fabric, which would be the side opposite the tuck row that was racked, as in half fisherman's rib.

3. The direction in which the stitches slant will depend on which bed does the racking and whether the racking bed has just knitted or just tucked. If it has just knitted, and the opposite bed has tucked, the knit stitches on this bed will slant in the direction in which the bed was racked. If the racking bed has just tucked, and the opposite bed has knitted, the knit stitches of the opposite bed will slant in the opposite direction to that in which the bed was just racked.

In the half fisherman's rib swatch knitted on Passap (shown in the first photo), the back bed was racked one needle to the left, then one needle to the right, with two rows knitted between rackings. Racking was done only after the front bed tucked, to create the all-over zigzag effect.

In full fisherman's rib, if racking occurs every two rows, the zigzag racked effect will show on one face only, as in the center swatch of the first photo. If you want it to show on both faces, as in the bottom swatch, then rack twice in succession in the *same* direction,

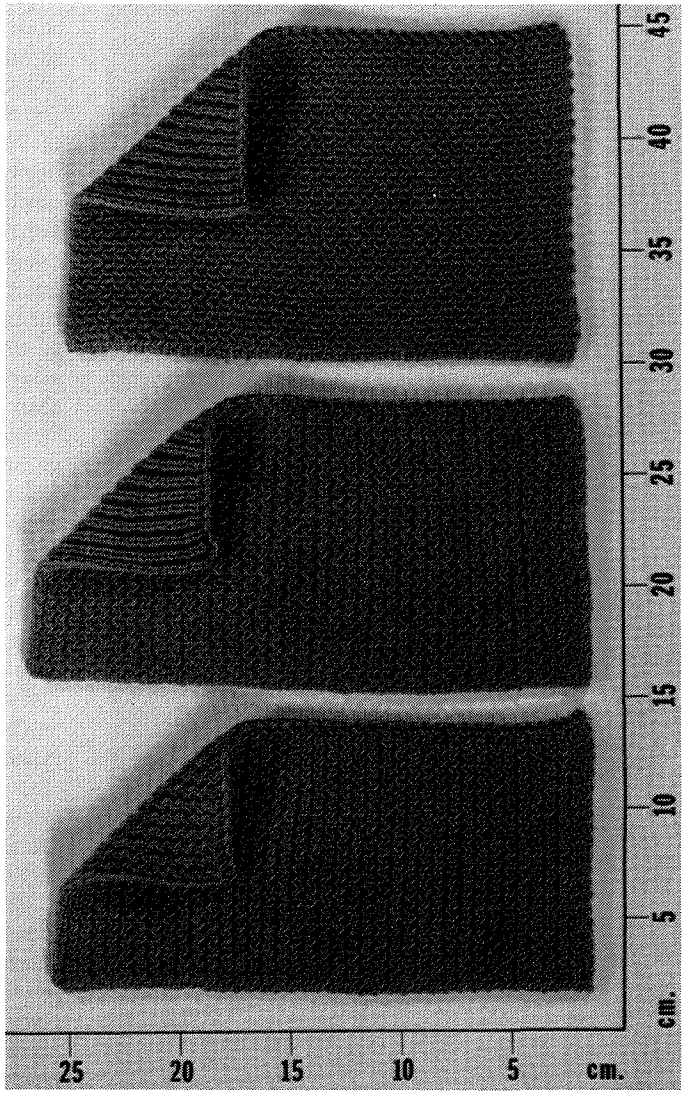
with 1 row between rackings (for example, twice to the left, then twice to the right), since the first and third rackings will affect one bed only, and the second and fourth rackings will affect only the other bed. This is also true in the horizontal herringbone pattern; if you rack one needle left, then one needle right with one row between rackings, the stitches on both faces of the fabric will slant in the same direction, and create a bias fabric. To change the direction of the bias, knit one row without racking after it, to put the carriage on the opposite side and so break the sequence. Then start again with the racking sequence.



The diagram illustrates the first three basic principles of racking.
Set-up: FNR.
Principle 1. Racking occurs after a tuck row has been knitted on one of the beds.
Principle 2. The effect of the racking will show in the knitted stitches of the front bed.
Principle 3. The stitches on the front bed will lean to the right.

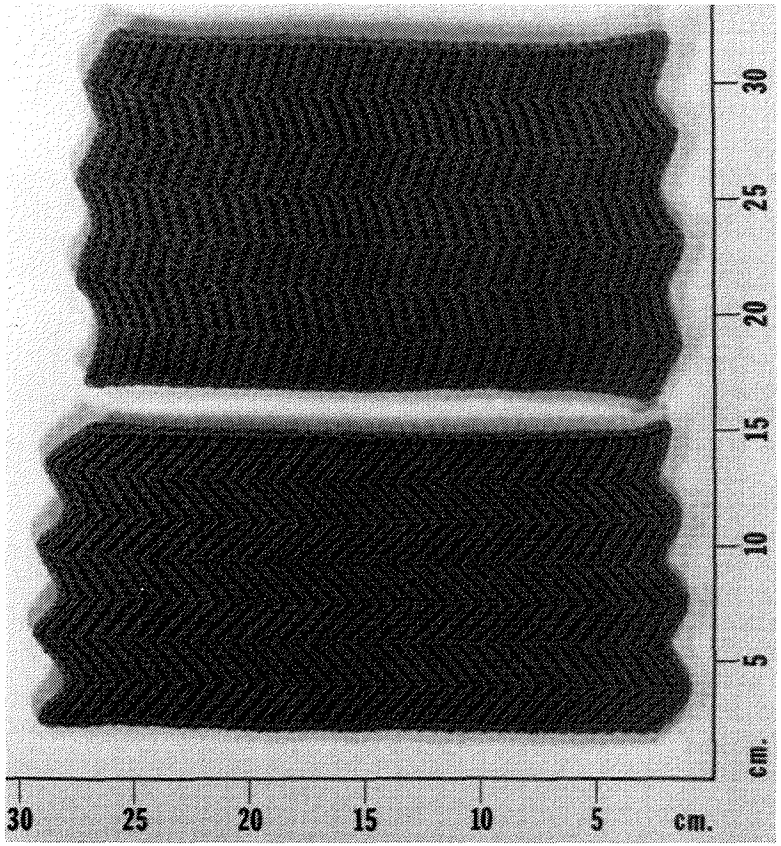
	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Basic setting: Full Fisherman's Rib	EX / EX R-L: tuck / knit ; L-R: knit / tuck	⊂⌒ / ⊃⌒ L-R: knit / tuck ; R-L: tuck / knit	← tuck / N tuck L-R: knit / tuck ; R-L tuck / knit	o tuck △ / 1 ∩ o L-R: knit / tuck ; R-L: tuck / knit
Basic setting: Half Fisherman's Rib	N / EX or EX / N	⊂⌒ / ∧ or ∧ / ⊃⌒	← tuck / N N or plain / N tuck	o tuck △ / 1 1 or o stock o / 1 ∩ o
Racking direction	back bed racks 1st rack is to L	front bed racks 1st rack is to R	front bed racks 1st rack is to R	front bed racks 1st rack is to R

Note: racking sequence for each fabric is given in the caption for the swatch photo.



Unless otherwise noted, the set-up for all swatches in this chapter is FNR. "Rack one space" means to make the first rack by one needle either left or right, depending on your machine. "Rack one space back again" means to rack in the opposite direction. See the cam chart.

Plain racked fabrics with straight selvedges. These swatches illustrate basic principles 1 and 2.
*Top. Half fisherman's rib. The racking shows on one face. *Knit 2 rows, rack 1 space. Knit 2 rows, rack 1 space back again.* For another effect, reverse the cam settings between beds.*
*Center. Full fisherman's rib. The racking shows on one face. *Knit 2 rows, rack 1 space. Knit 2 rows, rack 1 space back again.* If you wish to make the racked effect show on the opposite face while on the machine: knit 1 row, rack 1 space. *Knit 2 rows, rack 1 space back again, knit 2 rows, rack 1 space.* End with knit 1 row, rack 1 space back again.*
*Bottom. Full fisherman's rib. The racking shows on both faces. *Knit 1 row, rack 1 space. Knit 1 row, rack another space in the same direction. Knit 1 row, rack 1 space back again; knit 1 row, rack another space back again in the same direction.* Try this in half fisherman's rib, too.*

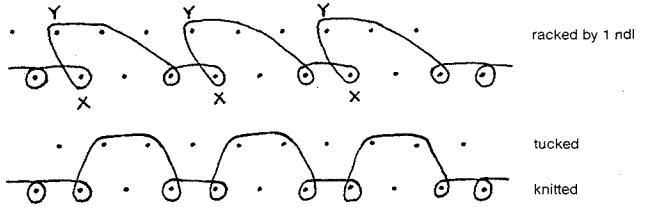


Fabrics with horizontal bias and zigzag side selvedges, illustrating basic principle 3. Horizontal herringbone pattern. The knitting instructions below are for both fabrics.
Top. Half fisherman's rib.
Bottom. Full fisherman's rib.
**Knit 1 row, rack 1 space; knit 1 row, rack 1 space back again.* Continue to RC12. Do not rack after RC12. *Knit 1 row, rack 1 space back again; knit 1 row, rack 1 space.* Continue to RC24. Do not rack after RC24. Start again from the beginning. This makes one full herringbone repeat. Omitting the racks after RC12 and RC24 breaks the sequence and starts the bias in the opposite direction.*

PATTERNING

There are two ways to create patterns with straight and slanted stitches on the same face of the fabric. Needles can be left out of work in such a way that those remaining will vary in their consecutive order when racked. Or punchcards or pushers can be used to select needles for knit and tuck on the same bed simultaneously. The photos illustrate how the same pattern can result from either method. Once you understand how these two methods work, you can create an endless variety of racked patterns, using either method alone or the two together.

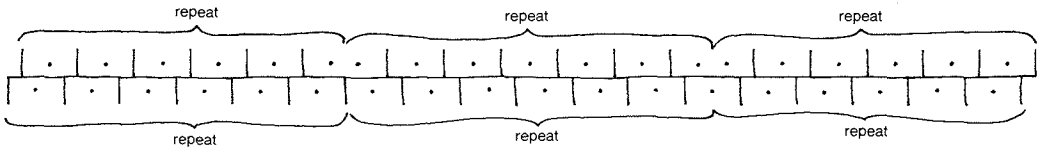
4. For a given knit stitch to show the slanted effect of racking, it must, when racked, cross all the way behind or in front of a needle on the opposite bed which will knit on the next row, to change the consecutive knitting order of the needles. If the racked stitch crosses a space where a needle is in NWP, or where a needle will tuck, rather than knit, on the next row, the given knit stitch will be straight instead of slanted, since the consecutive order will not change. In other words, it doesn't matter whether the given knit stitch will knit or tuck on the next row, but it does matter whether the stitch crossing behind it will knit or tuck on the next row. This is because a tuck stitch is not a stitch, but a loop. It slips and slides behind a knit stitch and therefore is not capable of fixing the racked effect into the fabric.



The diagram illustrates the fourth basic principle of racking. Set-up: 2x1 rib (plain dots are needles in NWP).
Principle 4. Each stitch marked x *on the front bed will show the effect of racking, since an occupied needle (marked* y*), which will knit on the next row, has crossed behind it, thus changing the consecutive knitting order of the needles. The other stitches on the front bed will remain straight.*

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Check in Half Fisherman's Rib with ndl selection MB	N / AX ↔ *push 6x6 WP/RP*	6x6 card - ER	6x6 card - ER tuck ↔ / N N	6x6 card - ER △ tuck △ / 1 1
Check in Full Fisherman's Rib with ndl selection both beds	AX ↔ push 6x6 RP/WP / AX ↔ push 6x6 WP/RP	6x6 card - ER On 2nd bed, select ndls with 6x6 patt ruler ER, so that selected ndls will face tuck ndls on MB.	6x6 card - ER tuck ↔ / tuck ↔ On 2nd bed, select ndls with 6x6 patt ruler ER, so that selected ndls will face tuck ndls on MB.	6x6 card - ER △ tuck △ On 2nd bed, select ndls with 6x6 patt ruler ER, so that selected ndls will face tuck ndls on MB.

Note: racking sequence for each fabric is given in the caption for the swatch photo.



Set-up for the bottom swatch in the photo at right. Two sets of brackets make a complete repeat consisting of one plain check and one patterned check.

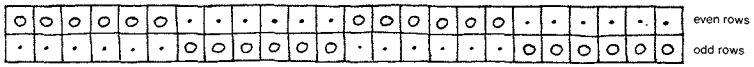
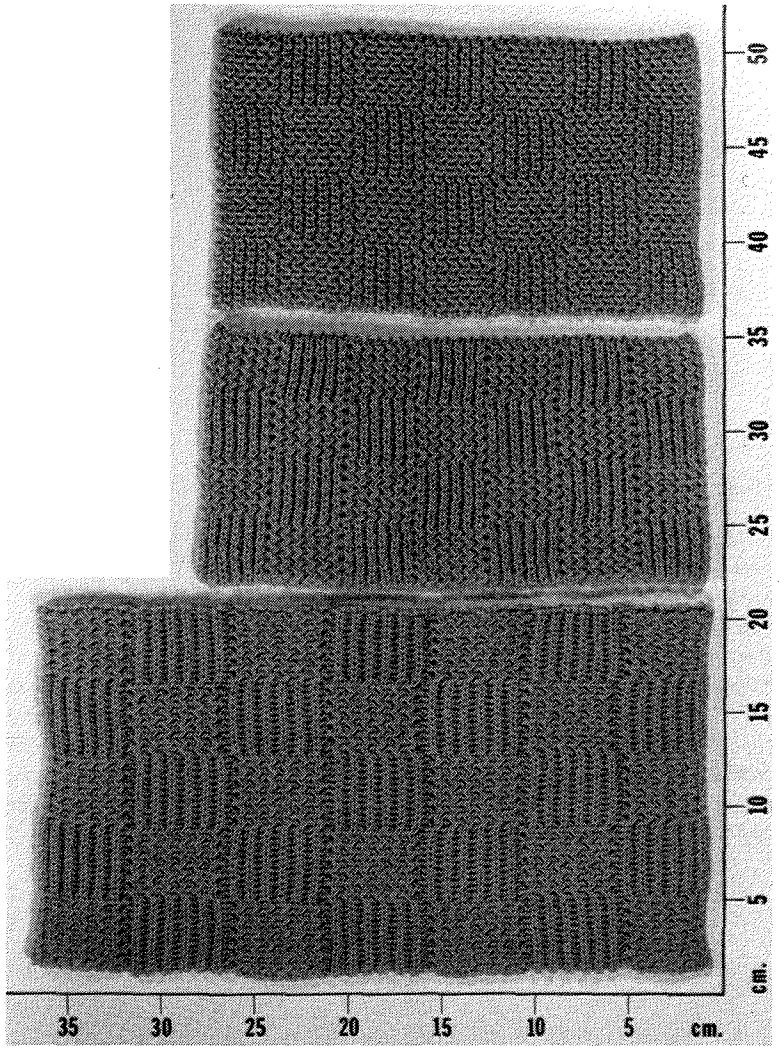


Diagram of 6x6 punchcard for Superba and the Japanese machines, to be used with the racking patterns on this and the following pages. Repeat: 2 rows, 12 stitches.

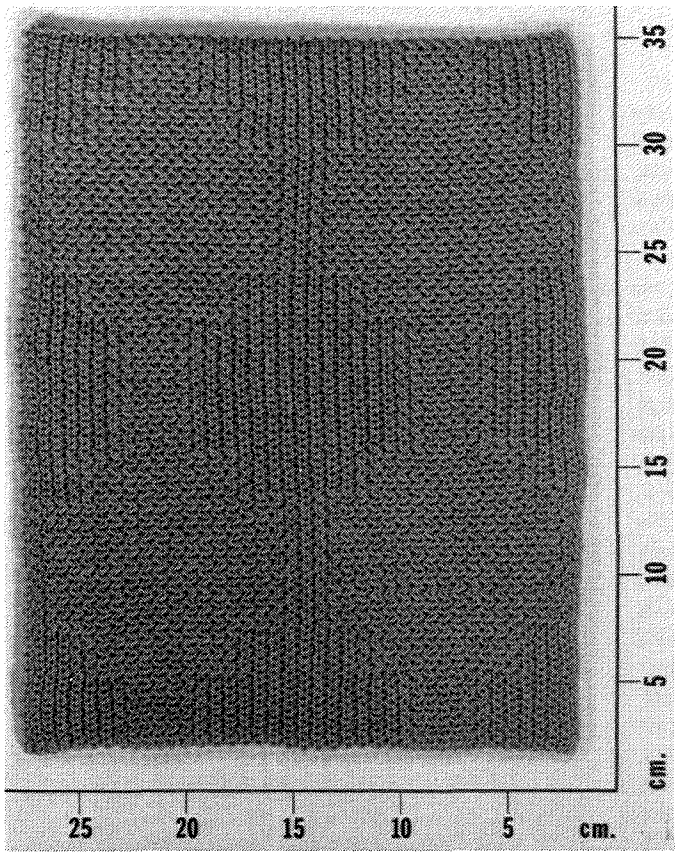


Checkerboard pattern, illustrating basic principle 4.
*Top. Half fisherman's rib, made in FNR set-up with 6x6 selection on MB only. The racked pattern shows on the opposite face. *Knit 2 rows, rack 1 space; knit 2 rows, rack 1 space back again.* Repeat for 20 rows, ending with final "rack back again." Knit 1 row without racking. Start the 21-row sequence again. For each sequence, the carriage starts from the opposite side. See cam chart and punchcard diagram. The punchcard rotates continuously and the cam setting remains the same throughout.*
Center. Full fisherman's rib, made FNR with ndl selection on both beds. The racked pattern is reversible. The knitting directions are the same as for half fisherman's rib. See the cam chart for settings.
*Bottom. Full fisherman's rib, made in 1x1 set-up (half-pitch) with both carriages set for fisherman's rib. No needle selection. The racked pattern shows on one face only—the back bed. *Knit 2 rows, rack 1 space; knit 2 rows, rack 1 space back again.* Continue to RC24, ending with final "rack back again." Repeat the sequence, but start racking in the opposite direction: the same direction as the last rack of the prior sequence.*

*Half fisherman's rib, jacquard Pattern 7. Needle selection on the MB only; the racked effect shows on the opposite bed. *Knit 2 rows, rack 1 space; knit 2 rows, rack 1 space back again.* Each pattern row is knitted RC4.*

	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Vertical Herringbone 1 color Half Fisherman's Rib	N / AX ↔ push 6x6 WP/RP	6x6 card - ER / ⌒ / ∧	6x6 card - ER / tuck ↔ / N N	6x6 card - ER / △ tuck △ / 1 1
Vertical Herringbone 2 colors Half Fisherman's Rib RC2 each color	N / AX ← push 6x6 WP/RP	6x6 card - EOR / ⌒ / ∧	6x6 card - EOR / tuck ↔ / N N	6x6 card - EOR / △ tuck △ / 1 1

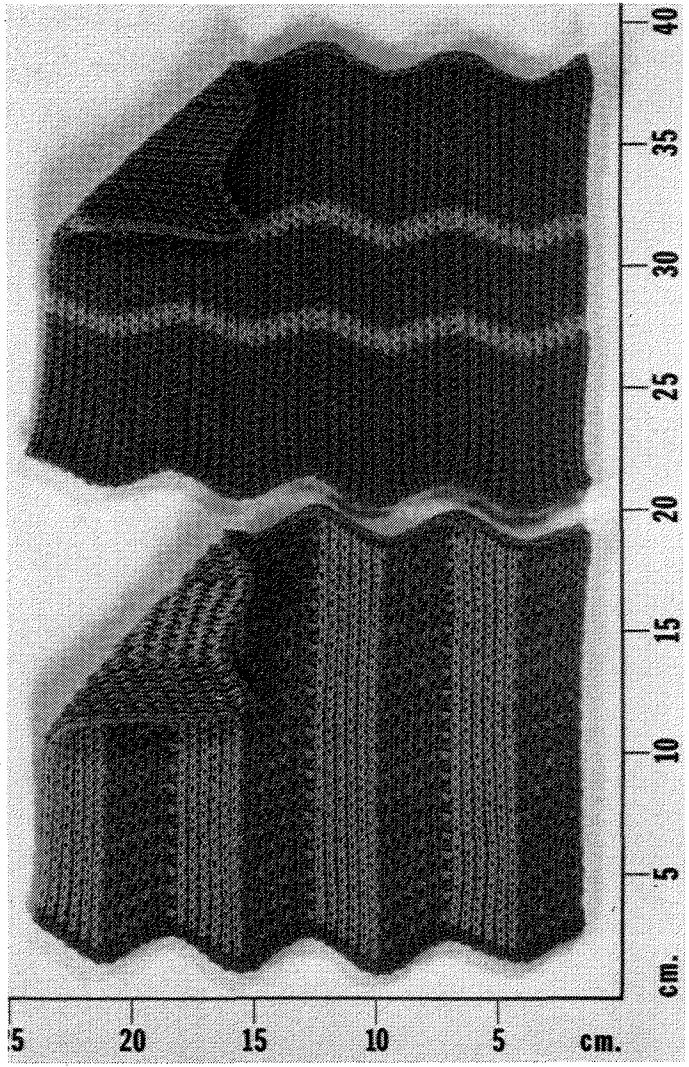
Note: racking sequence for each fabric is given in the caption for the swatch photo.



Note: racking sequence for each fabric is given in the caption for the swatch photo.

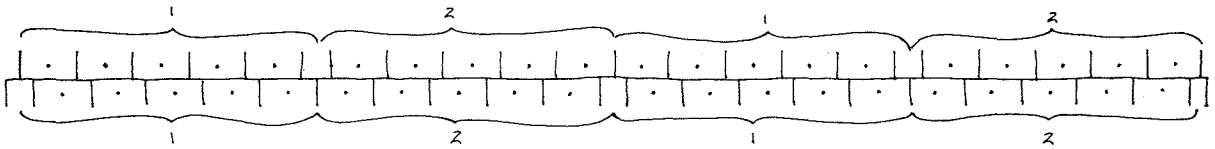
	Passap carr R	Superba carr L
Jacquard Pattern with punchcard - Half Fisherman's Rib	Type A / N / AX ↔ Deco 4	Type A - stop card change patt rows every RC4 / ⌒ / ∧ / RC 1 pos rev, RC1 neg rev

Vertical herringbone pattern with top and bottom selvedges zigzagged, illustrating basic principle 4.
*Top. Half fisherman's rib, in one color or in horizontal stripes, made in FNR set-up with ndl selection on the MB only. *Knit 1 row, rack 1 space, knit 1 row, rack 1 space back again.* Repeat. Look at the cam chart for settings.*
*Bottom. Half fisherman's rib in two-color vertical stripe, made in FNR set-up with ndl selection on the MB only. *Knit 2 rows with col 1, rack 1 space. Knit 2 rows with col 2, rack 1 space back again.* Repeat. See the cam chart for settings.*

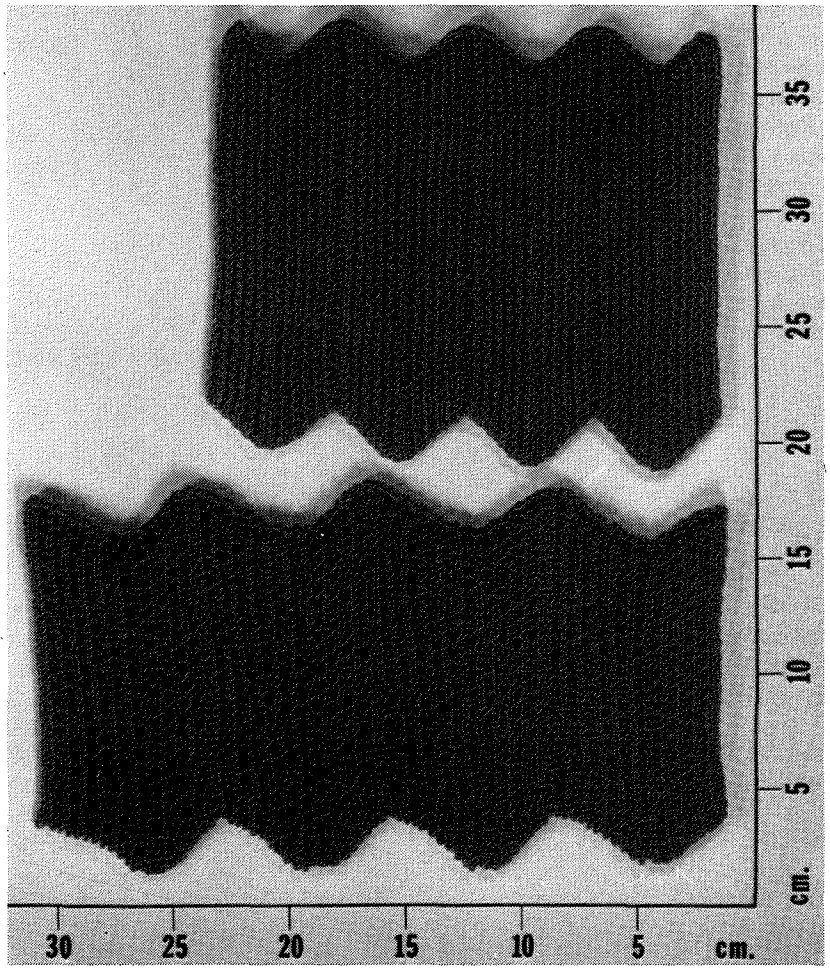


	Passap carr R	Superba carr L	Brother/Knitking carr L	Singer/Studio carr L
Vertical Herringbone 1 color Full Fisherman's Rib	AX ↔ push 6x6 RP/WP AX ↔ push 6x6 WP/RP	6x6 card - ER ⌒ ⌒ On 2nd bed, select ndls with 6x6 patt ruler ER, so that selected ndls will face tuck ndls on MB.	6x6 card - ER tuck ↔ tuck ↔ On 2nd bed, select ndls with 6x6 patt ruler ER, so that selected ndls will face tuck ndls on MB.	6x6 card - ER △ tuck △ o ∩ o On 2nd bed, select ndls with 6x6 patt ruler ER, so that selected ndls will face tuck ndls on MB.

Note: racking sequence for each fabric is given in the caption for the swatch photo.



Set-up for the bottom swatch in the photo below. Numbers 1 and 2 together make one repeat.



*Top. Full fisherman's rib in one color, made in FNR set-up with ndl selection on both beds. *Knit 1 row, rack 1 space; knit 1 row, rack 1 space back again.* Refer to cam chart for settings.*

*Bottom. Full fisherman's rib in one color, made in 1x1 set-up in half pitch. No ndl selection on either bed; both carriages set for fisherman's rib. Both faces of the fabric are identical. Unlike the other patterns, this one has three racking positions: left, center, right; or right, center, left, depending on your machine. The center position is the starting set-up. *Knit 1 row, rack one space; knit 1 row, rack back to center; knit 1 row, rack in same direction again; knit 1 row, rack back to center.* Repeat.*

HINTS FOR KNITTING RACKED PATTERNS

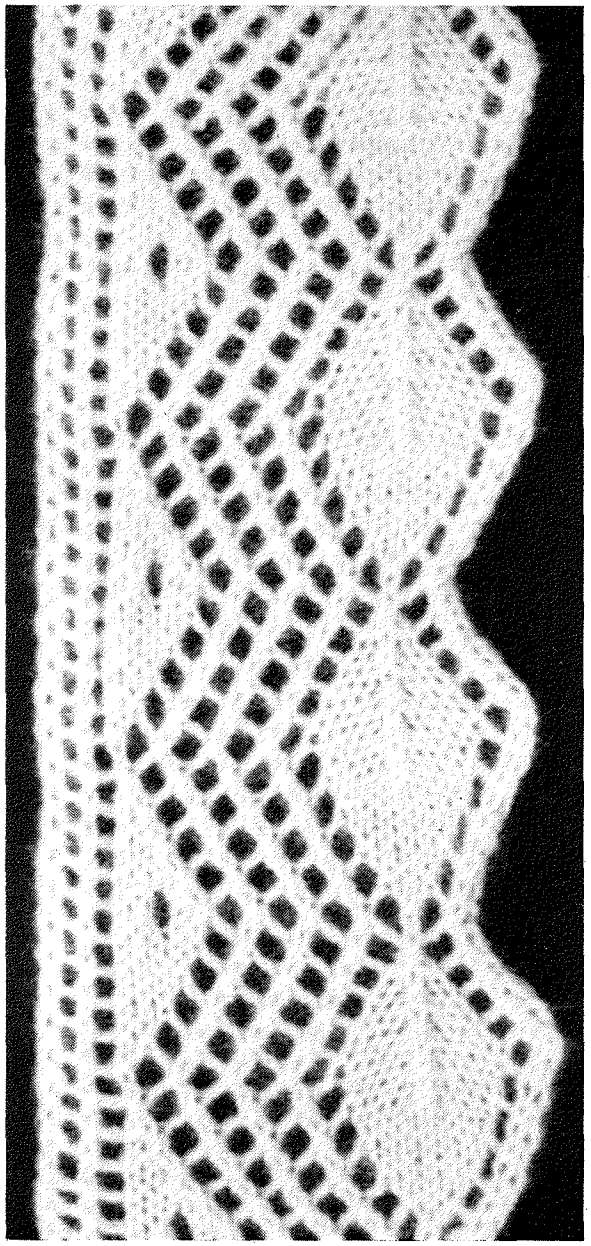
For most knitters, the bane of racking is the hypnotic effect of knitting sequence after sequence. One's attention seems to lapse just when it is needed to keep the knit/rack sequence in proper order. Then there are interruptions and other distractions, like a ringing telephone. To keep track of what you are doing, try the following:

1. Make a diagram of the needle set-up at the beginning of the pattern. Most racking sequences move out of, then back into, the starting set-up.
2. If you can't remember whether or not you just racked, or in which direction you racked, look at the slant of the stitches. If they are pulled diagonally, racking has occurred. If they appear in the normal zigzag pattern, racking hasn't occurred. Most machines have an arrow on the racking scale, showing the direction of the last rack.
3. Make note of the number of rows in a sequence, and of its multiples. Then during knitting, if you forget how many rows there are to the end of a sequence, you can figure it out from the row counter.

OTHER TECHNIQUES FOR KNITTING RACKED PATTERNS

1. The usual needle rule for the starting set-up in a racked pattern is the same as the normal needle rule for all double bed knitting. On Passap, the first rack is generally to the left (the back bed racks). On other machines, the first rack is generally to the right (the front bed racks), so the racked position is exactly opposite the usual needle rule for all machines.
2. Beds are always at half pitch.
3. Use a stitch size slightly larger than usual, to accommodate the stretch during racking.
4. Check the racked position of the beds before setting up the needles. They should usually be centered.
5. Rack beds in a backward sequence when ripping out rows.
6. When setting up, first go through the racking sequence with empty needles, and add extra needles where necessary for selvedges. A tuck loop at the end of a row on an exposed selvedge needle will always drop at the start of the next row, so an adjacent needle must be knitting on the opposite bed to "guard" it. This must be watched when increasing and decreasing as well.

CHAPTER 14
Lace



Lace is a wonderful, intricate fabric whose floating patterns seem made with light, space and a touch of the fantastic! Truly, lace *is* spun of air, for its most significant feature is open spaces framed and shaped by thread.

Actually, lace is composed of three elements: openings, lines, and solid areas.

The openings -- eyelets or spaces -- are the most integral part of the fabric design. If there are no open spaces, it isn't lace.

A linear element is necessary to outline the openings and/or to add design dimension within solid areas. In traditional hand knitted lace, the lines are created by knitting stitches together (decreasing), which in a sense pulls stitches away from other stitches to leave an opening. Mesh patterns, in any lace technique, are composed entirely of lines and spaces and are the basic web upon which all lace designs are built.

Solid areas may or may not be present in a lace design. They can be segments of plain or textured knitting suspended in the mesh, or they might be part of an intricately balanced pattern of lines and shapes which appear to hover within the mesh. In still other fabrics, the pattern may be a more solid one, pierced by spaces which frame the design much as perforations would.

Lace can be knitted with almost any kind of yarn, and can be delicate and airy or solid and stable. Laces are usually knitted in only one color to better accentuate the open spaces and textural areas. However, if used carefully, colors can certainly enrich many designs. Lace techniques can be combined with each other, and with other knitting techniques, as can be seen in the photographs. Some of the illustrated fabrics are "borderline" lace fabrics—made with lace techniques, but in such a way that the openness of the fabric disappears and is replaced by a texture not obtainable by any other means. When you start practicing, select for the principal part of your fabric those techniques which your machine does easily, and use manual methods in other techniques for decorative touches.

There are five general ways to knit lace by machine. Each machine has a method which makes use of automatic or special features and accessories of that machine. However, all the techniques given here can be done, more or less manually, on all the machines. A brief description of the five techniques is given below.

Lace made by lateral transfer of stitches.

Lateral transfer lace is the specialty of Brother/Knitking and Singer/Studio. With their lace carriages, they can quickly accomplish lateral transfer of stitches in a stockinette fabric on the main bed. The openings are well-shaped eyelets, and the lines in the fabric are made by knitting two or three stitches together, as in traditional hand knitted lace.

Lace made by cross bed transfer of stitches.

This method is the specialty of Passap and Superba. The fabric looks very similar to lateral transfer lace, but is based on a rib structure rather than stockinette. Stitches are transferred from one bed to the other with a cross bed transfer carriage. As in lateral transfer lace, the eyelets are created by the first row of new stitches on the empty needles, and are large and well shaped. The lines in the fabric actually are embossed ribs, which can be periodically transferred to the main fabric.

Lace made by dropping stitches.

This technique can be done easily on all machines. Stitches knitted on one bed are dropped, while those on the other bed are retained. The yarn from the dropped stitches is taken up by the adjacent retained stitches on the opposite bed, which become much larger. The spaces thus created contrast with the normal knitted stitches.

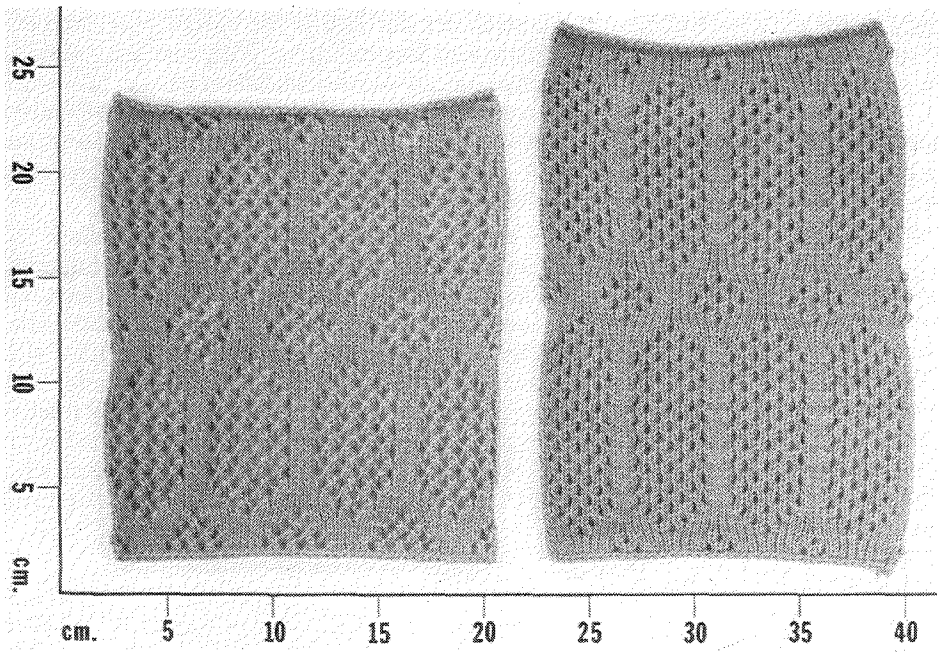
Lace made with transparent thread.

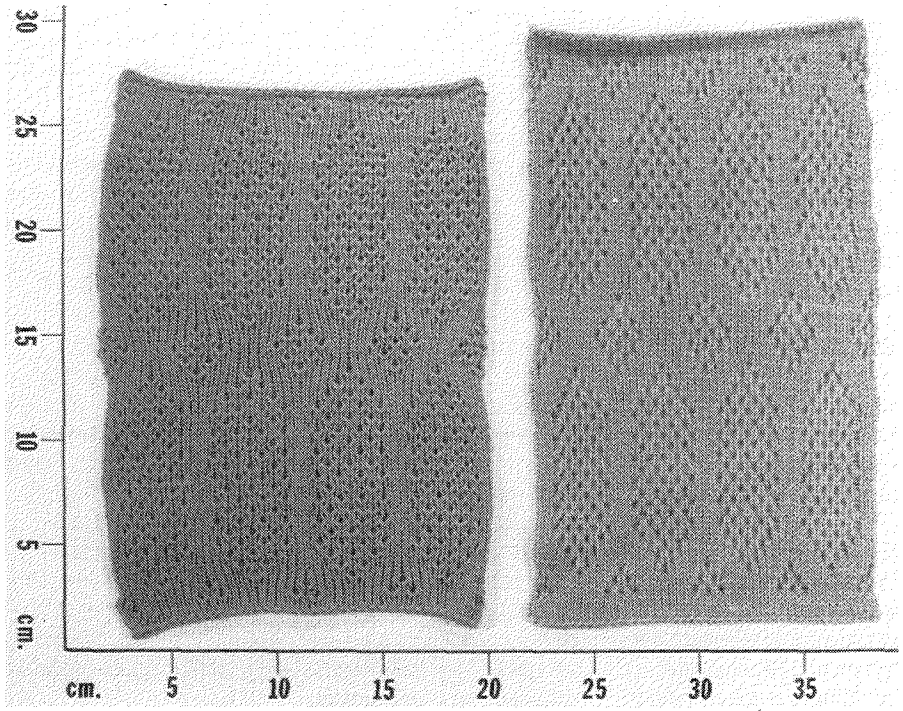
This fabric is the specialty of the Singer/Studio, and actually is a two-color solid fabric composed of yarn and a transparent thread. It creates an illusion of openings where there actually are none. The technique is a jersey jacquard one, and it can easily be adapted to all machines.

Lace made by leaving needles out of work.

This is another method which can be done easily on all machines. The open spaces are created by threads crossing over spaces where needles are in non-working position. A variety of techniques can be used to create patterns in this kind of lace, such as lateral transfer, racking, tuck patterning, and short rows.

For the sake of comparison, the photographs on the next page illustrate one mesh made by the first four techniques. All were knitted with a basic 1x1 punchcard with taped-over holes (jacquard Pattern 1), to show how the same design looks when done in different lace techniques.





Four techniques, all using jacquard Pattern 1 with 1x1 mesh.
Left. Lateral transfer.
Right. Cross-bed transfer.

Left. Drop stitch.
Right. Transparent thread.

In the pages which follow, illustrations will show two or three meshes in each technique except the last, all made by a 1x1 needle selection. It is, of course, possible to make other meshes with other selections, such as 2x1 or 2x2. These meshes can be made with or without punchcards. Since meshes are the basis of all lace, it is important to practice each method. Meshes can incorporate solid areas of stockinette by masking some holes on a punchcard, as in the adjacent pattern; or, in a mesh made without a card, by drawing the design on the charting attachment and taking the corresponding needles in or out of work, as the case may be.

LACE MADE BY LATERAL TRANSFER OF STITCHES

In terms of patterning possibilities, this is probably the most highly developed and versatile of all the lace techniques. It is sometimes referred to as *true lace* or *real lace,* and the technique produces lace exactly like that made by the centuries-old hand knitting methods known throughout the world. The library of traditional hand knitted lace patterns is enormous, and most of them can be adapted to knitting machines, either as stockinette fabrics made on one bed, or for knit/purl patterns, on double bed.

In hand knitted lace, the basic elements in a pattern are a "yarn over" and a decrease. The yarn over is an increase, which makes an eyelet in the fabric; and the decrease, made by knitting two stitches together, is paired with the eyelet to keep the total stitch count constant from row to row. A lace pattern is determined by the arrangement of the yarn over and the decrease from row to row.

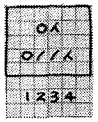
On knitting machines, the yarn over and decrease occur simultaneously. If a stitch is transferred laterally to an adjacent needle on the same bed, there will be two stitches on that needle, making the decrease. The empty needle, when knitted with the carriage, will have a new loop, which is the yarn over and which will make the eyelet.

There are two ways to pair the eyelet and the decrease in a pattern. In the first, a stitch is transferred to a needle right next to it, so the eyelet and decrease are side by side. Patterns made this way are known as *single transfer* patterns. The resulting fabric is punctuated by eyelets and all the stockinette stitches in the solid areas of the pattern will be in vertical alignment with the selvedges.

In the second method, known as *multiple transfer* patterns, the decrease and eyelet are spaced some needles apart. The eyelet will occur on one needle and the decrease on another needle several stitches away. All the stitches between must be moved over by one needle toward the decrease. These patterns are made as follows: the needle to contain the decrease is dealt with first by transferring the stitch from the adjacent needle, on the side where the eyelet is to occur. The next stitch is transferred to the empty needle, then the next, and the next, until the needle where the eyelet is to occur is reached. All stitches between the eyelet and the decrease will slant toward the decrease. If this kind of transfer is done on the same stitches for several rows, it will form another decorative element in the pattern by slanting the stitches in the stockinette areas and creating a scallop or zigzag bias at the top and bottom and sometimes at the side selvedges. Manual transferring of multiple transfer patterns can be done more quickly with a multi-decker tool, which moves all the stitches in a group at once.

Lateral transfer lace can be made manually on all machines. It can be made automatically on Brother/Knitking and Singer/Studio with the lateral transfer carriage, and on Passap and Superba with the U-80 and garter carriage.

Lace patterns for this technique are always drawn on a graph, using specific symbols to indicate positions of the decreases and eyelets in each pattern row, and the action of the other stitches. We advise that you learn how to read these graphs, even if your machine has a lace carriage, so you can punch cards from a graph of your own design. Many of the Japanese hand and machine knitting pattern books contain lace patterns, and the symbols used in their graphs are the ones used here. Those books are good sources for pattern ideas. Knitters who know how to graph patterns from hand knitting directions, or read hand knitting graphs, can use many traditional knitting patterns. There is one limiting factor to remember: unless the pattern is an edging, *all the rows within a repeat must have the same number of stitches.*



Upper row; single transfer. The eyelet is on needle 2 and the corresponding decrease on needle 3.
Lower row; multiple transfer. The eyelet is on needle 1 and the corresponding decrease on needle 4. Stitches 2 and 3 have been moved over one needle and will slant toward the decrease.

THE SWATCHES

To illustrate the many kinds of patterning possible in lateral transfer lace, we have photographed a large selection of swatches, and show them with the appropriate graphed designs and punchcard diagrams. The swatches include simple patterns which can be made manually on any machine, or with punchcards on machines with lace carriages. We have also included more complex punchcard patterning which involves shaped edgings, and combinations with tuck stitch, weaving, jacquard, and knit/purl patterns. Also illustrated is the use of the fine lace setting on Brother/Knitking to create solid fabrics from a multiple transfer lace pattern. Although the swatches shown were knitted with the special techniques described, they can be done manually on any knitting machine by following the graph for the charted design. Be sure to consult both your instruction manual and the explanations which follow the photographs for details concerning lacemaking on each machine.

Practice knitting these swatches. Then, if you wish to design or modify a pattern to suit your machine, keep in mind these two basic points. First, left and right transfers do more than create decreases and eyelets, they affect the bias of the fabric as well. If *either* a left *or* right transfer is made consistently throughout a pattern repeat, the fabric will bias in the direction opposite to the transfer, and the bias can be seen in the side selvedges of the fabric. If *both* transfers are incorporated in the same pattern row or on alternating pattern rows, the side selvedges will be vertical and the fabric will not bias. If opposing transfers are made in adjacent groups of stitches on successive pattern rows, the top and bottom selvedges will bias, forming scallops, but the side selvedges will not.

Second, when you graph your design, check each pattern row to make sure that the number of eyelets and decreases is equal. It's a good idea to start your graph by placing the eyelets in all the rows first, then positioning the decreases around them, including the diagonal marks for multiple transfers. Remember that all decreases which move left must be to the left of their eyelet on the graph, those which move right to the right of their eyelet, and double decreases must be between their eyelets.

SYMBOLS USED IN GRAPHED DESIGNS FOR LATERAL TRANSFER LACE

The following symbols are used on the graphed designs for the patterns. With the exception of the graphed designs for tuck stitch stockinette with eyelets and lace with weaving, all the graphed designs assume that each pattern row (one horizontal row of squares) is made up of two rows of stockinette, plus transfers. In the designs mentioned above, since the knit rows also incorporate tuck stitches or weaving, *all* the knit rows, plus transfers, are shown in the graphed design.

- O — Eyelet. The stitch on this ndl is transferred to an adjacent ndl; the empty ndl is left in WP.
- ⟍ — Left decrease. The stitch to the R of this ndl is transferred to this ndl so that it slants L. Two sts are now on this ndl. One eyelet is paired with this decrease on the graphed design.
- ⟋ — Right decrease. The stitch to the L of this ndl is transferred to this ndl so that it slants R. Two sts are now on this ndl. One eyelet is paired with this decrease on the graphed design.
- ⅄ — Double decrease. The stitch to the L of this ndl and the stitch to the R of it are both transferred onto it. Three sts are now on this ndl. Two eyelets are paired with this decrease on the graphed design.
- / — A knit stitch is moved over one ndl to the R in a multiple transfer pattern.
- \ — A knit stitch is moved over one ndl to the L in a multiple transfer pattern.
- ∩ — Tuck stitch.
- ⊓ — Weaving yarn above the stitch (put ndl in D pos.).
- ⊔ — Weaving yarn below the stitch (leave ndl in B pos.).

These symbols are used on the graphed charts for the punchcards. The notations on the sides of the punchcard are given adjacent to their relevant rows, so the card can be studied more easily. When you punch the card to be used in the machine, all the notations must be moved upwards by a certain number of rows, as described in Reference Chapter 4.

- **K** — K carriage, Brother/Knitking (markings in left column).
- **L** — Lace carriage, Brother/Knitking (markings in right column).
- **P** — Preparation row for L carr, Brother/Knitking.
- **F** — Fine lace setting on L carr, Brother/Knitking.
- **T** — Tuck stitch cam setting, Brother/Knitking.
- **PL** — Plain cam setting, Brother/Knitking.
- ⮌ — Move appropriate carr from R to L, then L to R, Brother/Knitking.
- ⮋ — Move appropriate carr from L to R, then R to L, Brother/Knitking.
- Λ — Plain lace cam setting on lace carriage, yarn in feeder, Singer/Studio.
- ⅄ — Fashion lace cam setting on lace carriage, yarn removed from feeder, Singer/Studio.
- × — 1 new ndl moved to WP before the row is knitted, Singer/Studio.
- ⊗ — 1 emptied ndl moved to NWP before the row is knitted, Singer/Studio.
- ← — Either a left transfer, or a row knitted R to L, all machines.
- → — Either a right transfer, or a row knitted L to R, all machines.

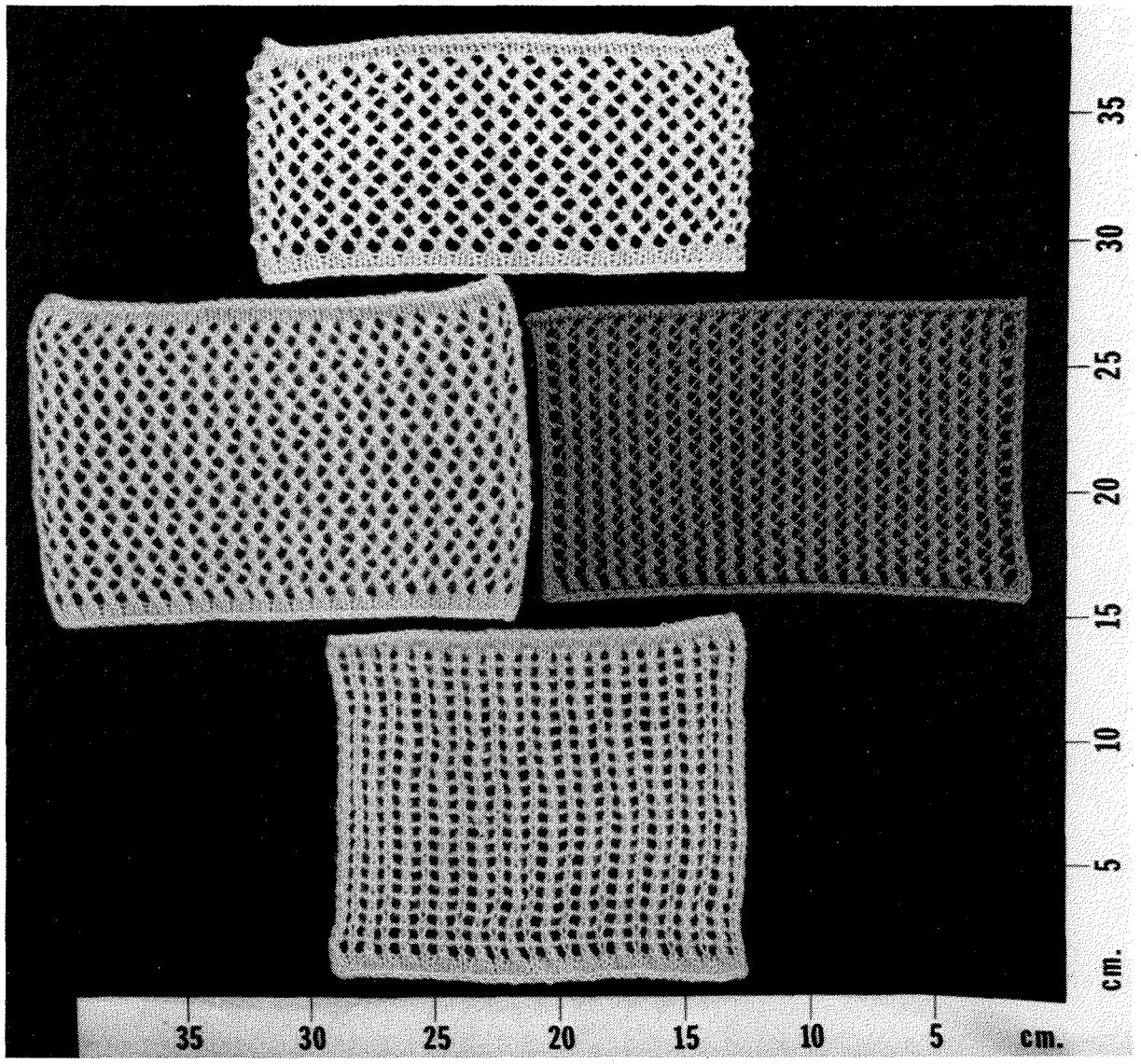
Single transfer mesh patterns (1x1) for all machines. Cast on the MB, using an odd number of ndls. Knit 2 rows of stockinette between transfers.

*Top. Vertical trellis mesh made without punchcard, for Passap and Superba. L and R transfers on alternate rows. *Knit 2 rows, transfer L; knit 2 rows, transfer R.* Set U-80 2, then 4, each transfer. Garter carr A, then B each transfer.*

Center left. Alternating vertical trellis mesh made with punchcard, for Passap, Brother/Knitking and Singer/Studio. L and R transfers on alternate rows.
Brother/Knitking: set K carr NL, plain.
*Singer/Studio: *Knit 2 rows with yarn, 2 rows without yarn.* A similar mesh can be made by using the punchcard for Brother/Knitking, with the plain lace setting throughout. It will make 3 knit rows between transfers instead of 2.*
*Passap: set up extra ndl each end without pusher for selvedges. All pushers BB WP. U-80 5. Set carr GX/N, no arrow key. Deco 2. *RC2, R transfer; RC2, L transfer.* Can be knitted without card by arranging pushers 1x1 WP/RP, and setting carr GX/N, left arrow key. Same knitting and transfer sequence.*

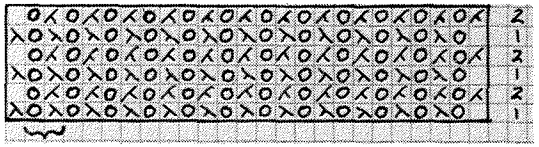
Center right. Faggoting pattern, a variation of alternating vertical trellis mesh at left. Made with the same punchcards, but with one knitted row instead of 2 between transfers. On all machines, the SS will probably have to be 1 or 2 numbers larger than normal to prevent dropped sts. See also the second comb stitch swatch, made by the same technique.
Passap and Brother/Knitking: set carr to slip 1 row of every 2. Slip row will alternate every pattern row since yarn end will be on the side opposite the carriage on alternate pattern rows.
Singer/Studio: this pattern can be knitted more automatically with card 1 from basic pack, carr set for plain lace throughout.

Bottom. Square mesh made with punchcard, for Brother/Knitking, Singer/Studio and Passap. L and R transfers on same row.
Brother/Knitking: K carr at NL, plain.

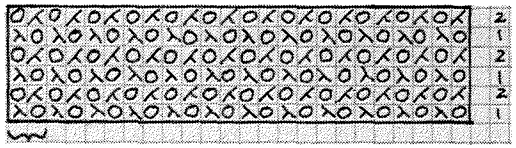


*Singer/Studio: Same punchcard as for Brother/Knitking. *Knit 2 rows without yarn, 2 rows with yarn.* If this card is used with plain lace setting throughout, it will make another mesh pattern.*

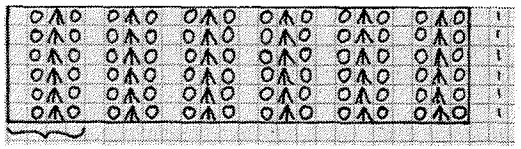
*Passap: U-80 5. All pushers BB WP. Set carr GX/N, Deco 2, uncoupled. *Make 2 passes with Deco alone, R transfer. Two passes with Deco alone, L transfer. RC 2 carriage alone.* (Row counter will read 2.)*



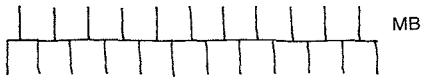
Design for vertical trellis mesh, Passap and Superba.



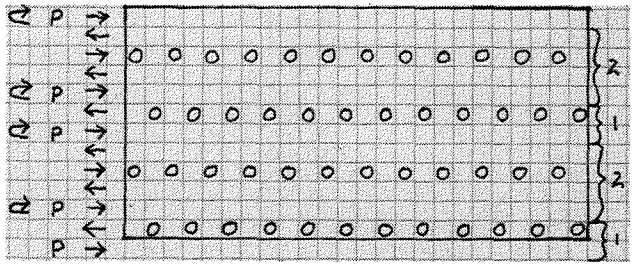
Design for alternating vertical trellis mesh, Japanese machines and Passap.



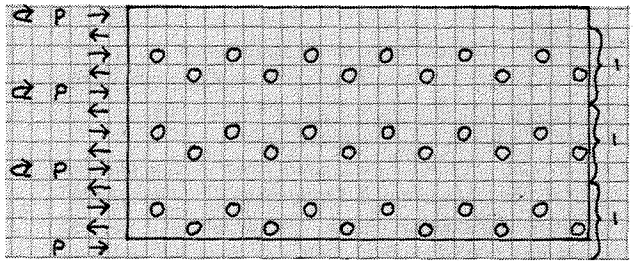
Design for square mesh, Japanese machines and Passap.



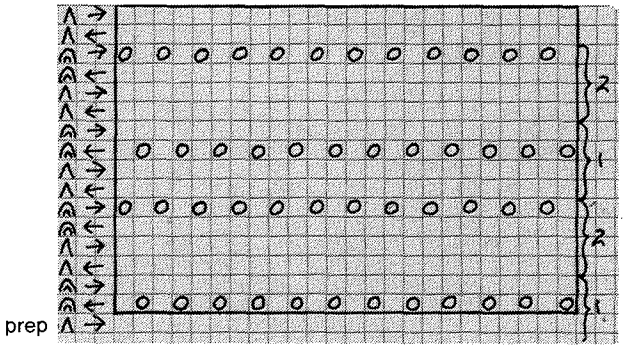
Vertical trellis mesh.



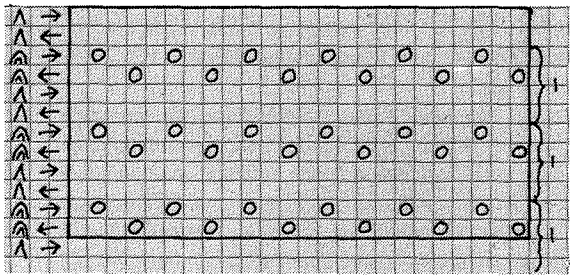
Alternating vertical trellis mesh, punchcard for Brother/Knitking.



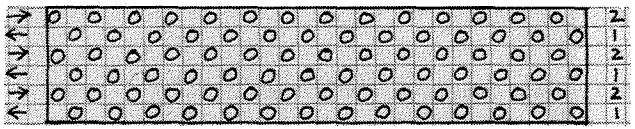
Square mesh, punchcard for Brother/Knitking.



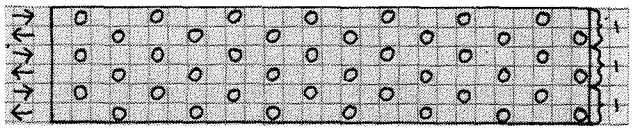
Alternating vertical trellis mesh, punchcard for Singer/Studio.



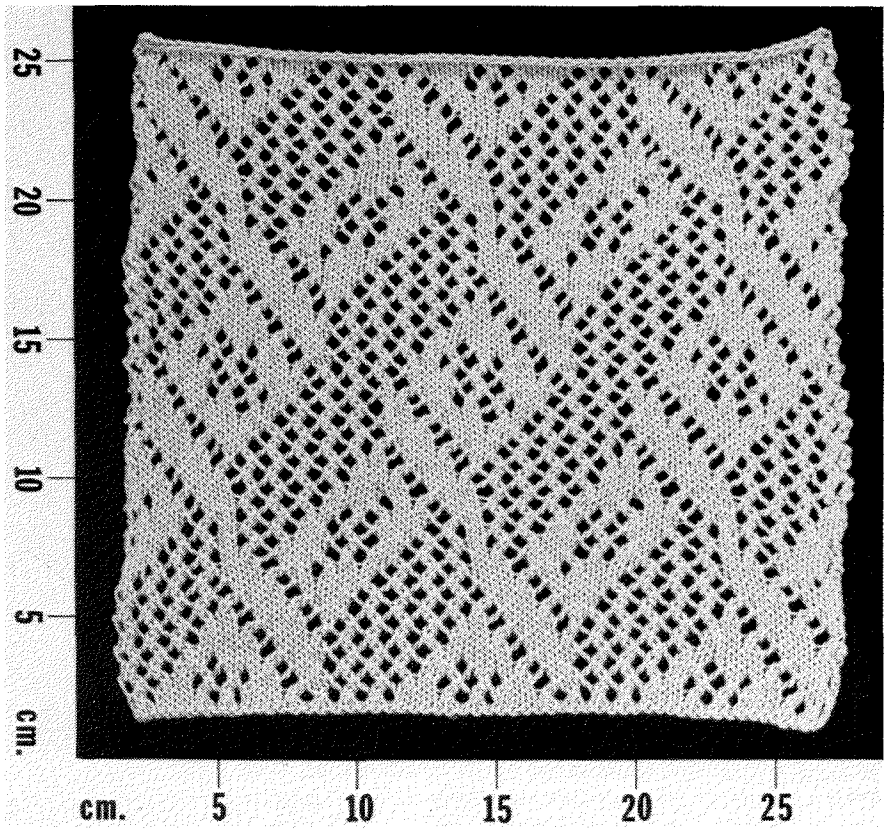
Square mesh, punchcard for Singer/Studio.



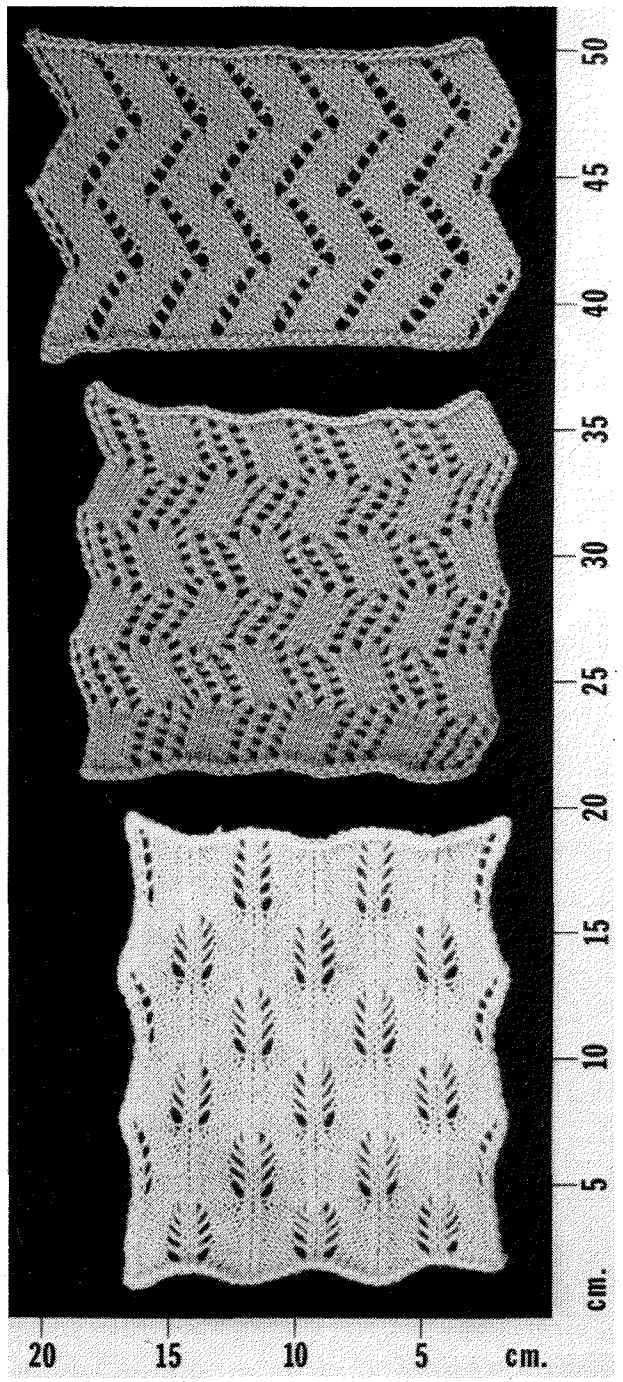
Alternating vertical trellis mesh, punchcard for Passap.



Square mesh, punchcard for Passap.



Jacquard Pattern 2, made on Passap. Use any Type A card with 1x1 punched background to make alternating vertical trellis mesh. Knitting sequence same as for alternating vertical trellis mesh.



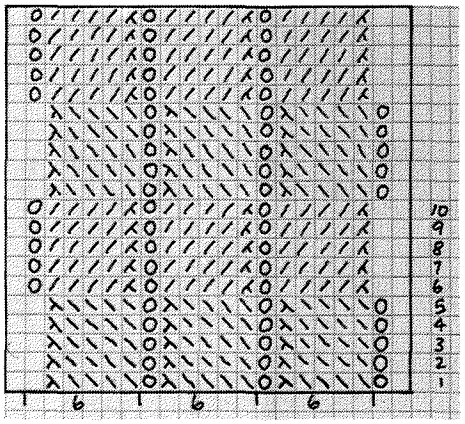
Multiple transfer patterns for Passap and Superba, made without punchcard. L and R transfers on separate rows. Knit 2 rows stockinette between transfers. On Passap put all pushers BB in WP. On Brother/Knitking and Singer/Studio, the next 3 patterns can be translated to punchcard, if desired (not illustrated).

Top. Bias zigzag.

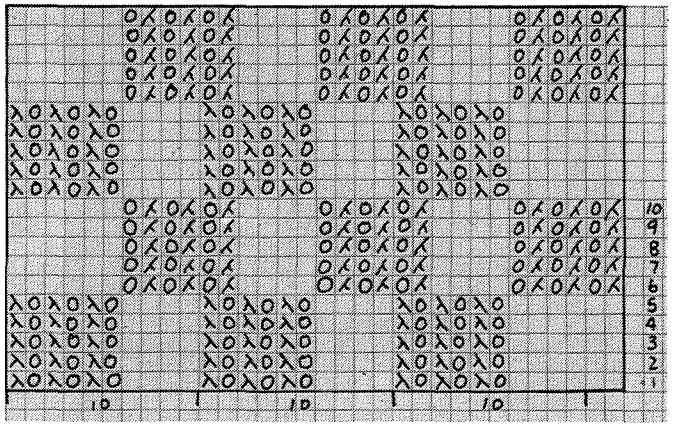
*Passap: U-80 1 or 5. Superba: garter carr AB. After transferring, put single sts into hooks or push ndls up to pos 2, to prevent dropping. Both machines: cast on MB. *Knit 2 rows, transfer L* 5 times. *Knit 2 rows, transfer R* 5 times. Repeat from beginning.*

*Center. Bias checks. Passap: U-80 1 or 5. Superba: garter carr AB. Both machines: cast on MB. *Knit 2 rows, transfer L* 5 times. Superba: rack 5 ndls. Passap: press left arrow key for next row only. *Knit 2 rows, transfer R* 5 times. Rack, or press left arrow key again. Repeat from beginning.*

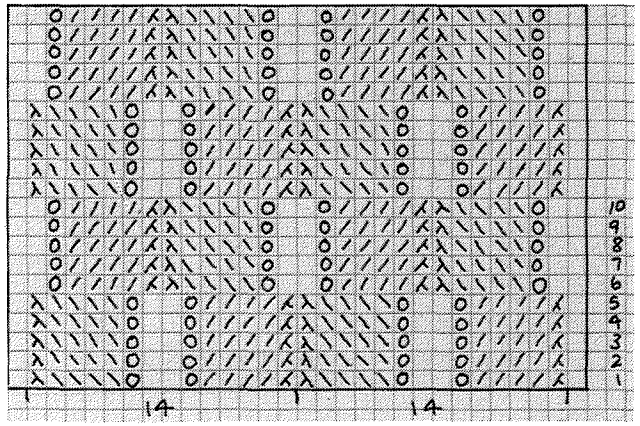
*Bottom: Waved ribbon pattern for Passap only. L and R transfers on the same row. All pushers BB in WP. U-80 1 or 5. *RC 2, GX/N, left arrow key, L transfer. RC 2, GX/GX, left arrow key, R transfer.* After RC20, reverse the L and R transfers; cam settings and knitting sequence remain the same throughout.*



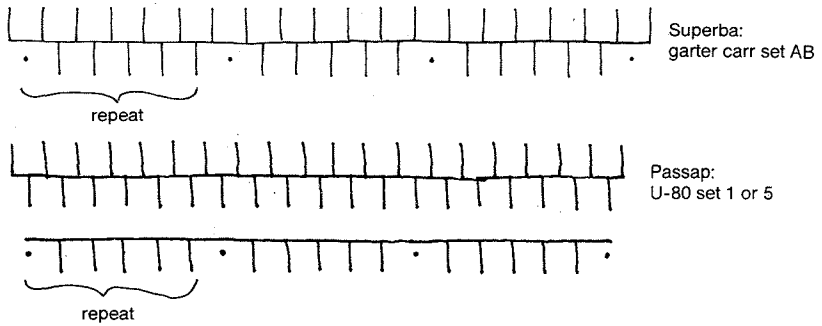
Design for bias zigzag.



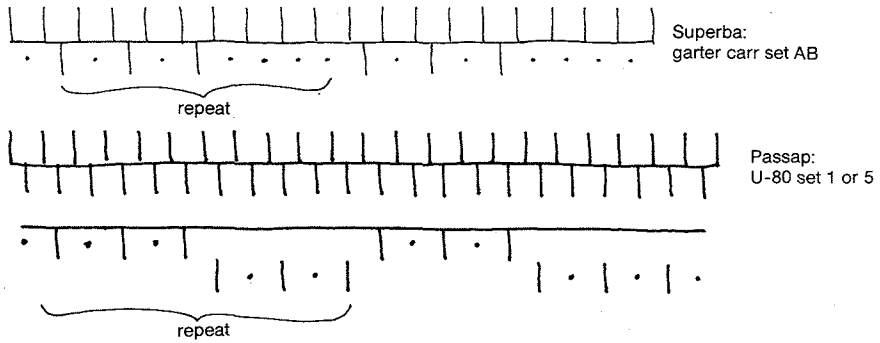
Design for bias checks.



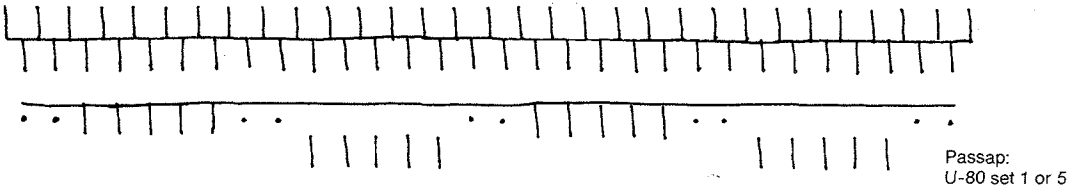
Design for waved ribbon.



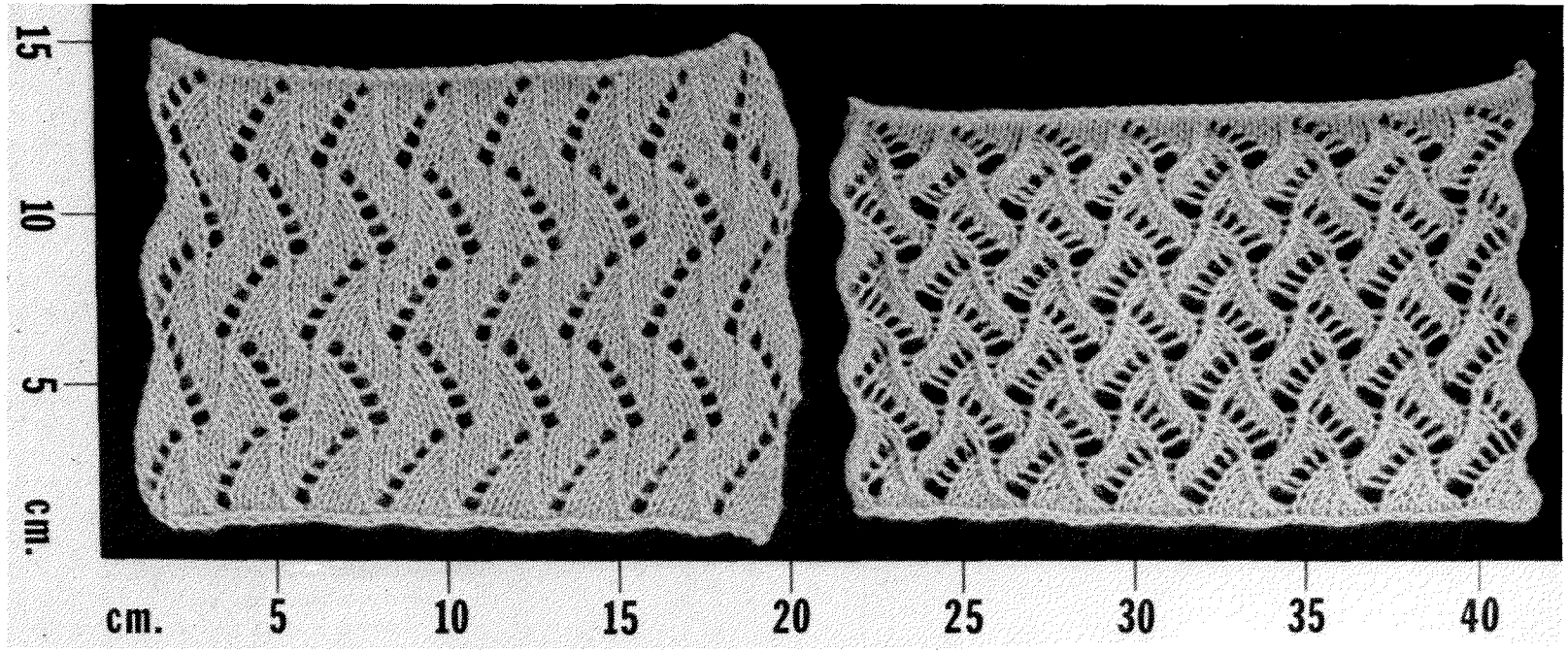
Bias zigzag.



Bias checks.



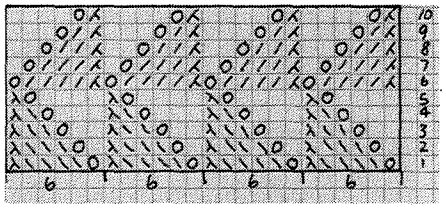
Waved ribbon.



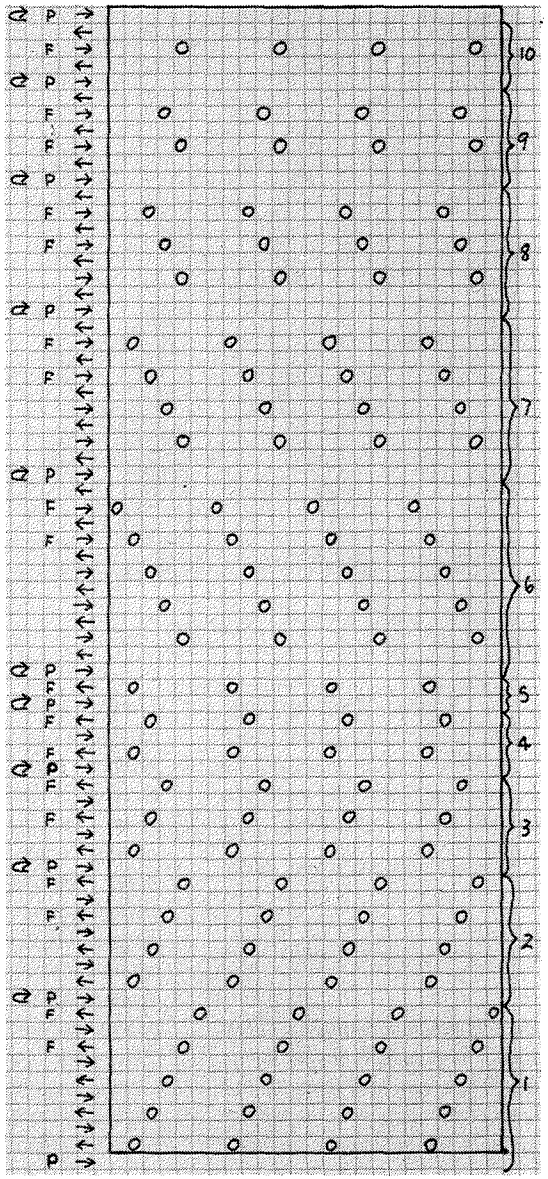
Comb stitch, a multiple transfer pattern for Brother/Knitking and Singer/Studio. Swatches in this photo can be made on both machines; other comb stitch swatches shown can be made only on Brother/Knitking. These patterns illustrate variations which can be incorporated into any multiple transfer pattern. The same punchcard can be used for all variations.

Left. Comb stitch knitted single bed; 2 knitted rows between transfers. Most lace patterns are knitted this way.
Brother/Knitking: set K carr to NL, plain.
Singer/Studio: knit 2 rows with yarn, on plain lace setting; knit transfer rows without yarn, on fashion lace setting.

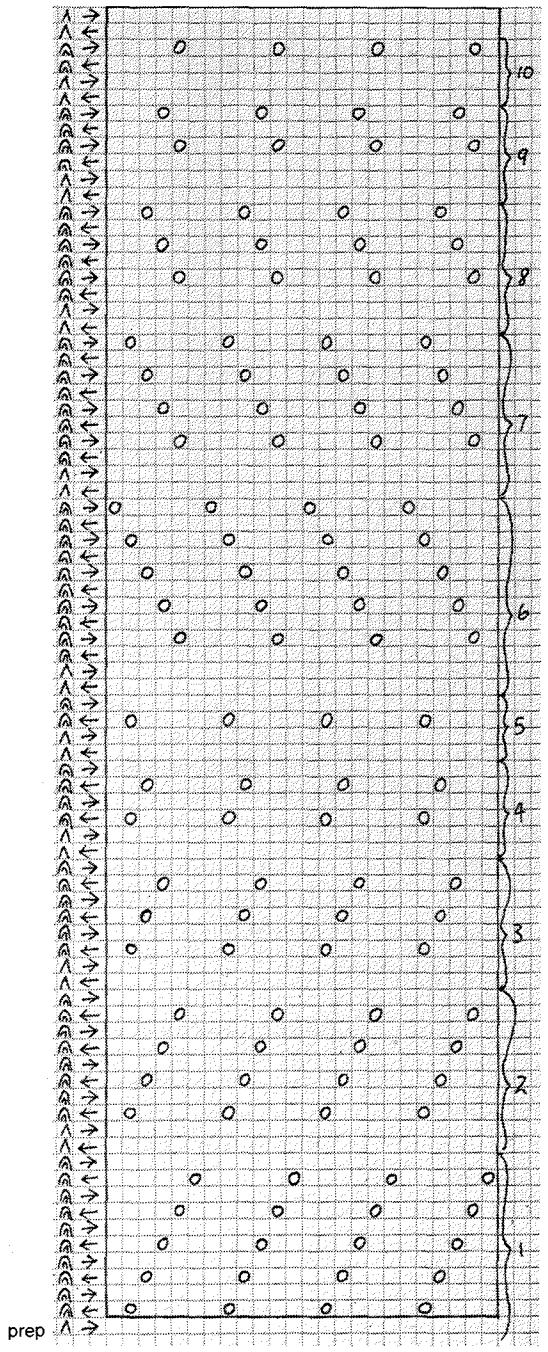
Right. Comb stitch knitted single bed; 1 knitted row between transfers. This variation is the original hand knitting pattern, from which the name is derived. For 1 knit row instead of 2 between transfers in any lace pattern, the carriages make the usual passes and start and end at the usual side, as for the swatch at left. But here, on the 2 knit rows, one of the two is slipped instead. On both machines, the SS will probably have to be enlarged and the weights carefully adjusted, as some of the transferred sts will be new loops after the previous transfer, and not fully formed sts.
Brother/Knitking: on the K carr, set NL, press either the left part button, if yarn is at left selvedge, or right part button, if yarn is at right selvedge. The selvedge where the yarn is located will alternate each pattern row. Yarn is never removed from the carriage; simply hold it down out of the way during transfers when it is at the left selvedge.
Singer/Studio: on one of the 2 knit rows provided for on the card (it will alternate each pattern row) the cam is set to the fashion lace setting, with the yarn removed, instead of the usual plain lace setting. When carriage moves across on fashion lace setting with no yarn, nothing will happen (a slip, or "free pass"), as there are no holes punched on the 2 knit rows. Therefore, on alternating pattern rows, yarn will be removed from the carriage and the cam setting changed to fashion lace while it is at the left *side. Then carr is brought back to right side on a free pass to begin the transfer sequence.*



Design for comb stitch, Brother/Knitking and Singer/Studio.

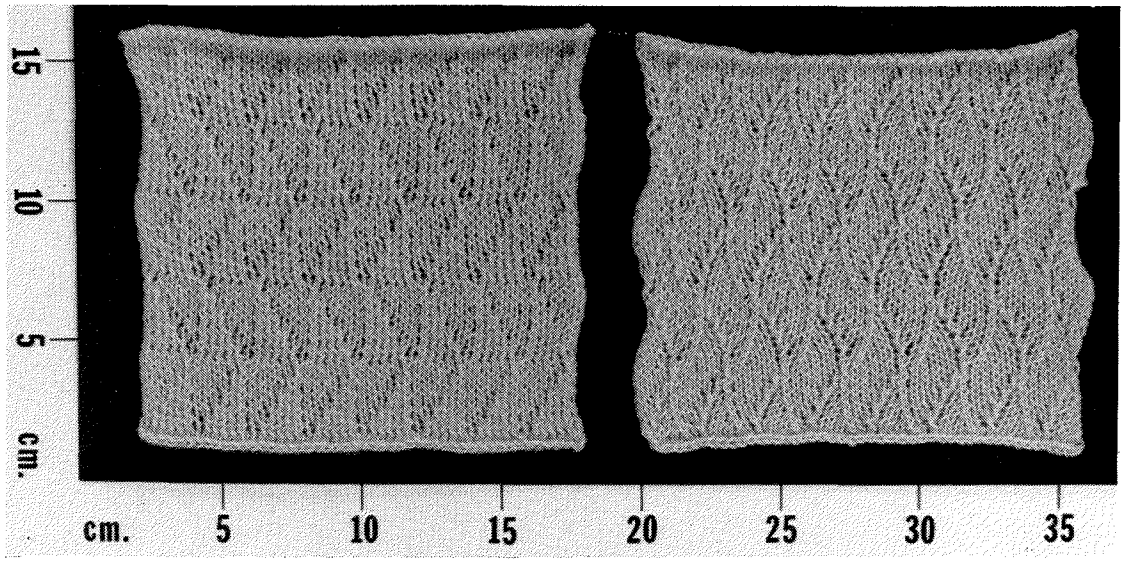


Comb stitch, punchcard for Brother/Knitking. The "F" markings on left side of card are notations for the fine lace variation.

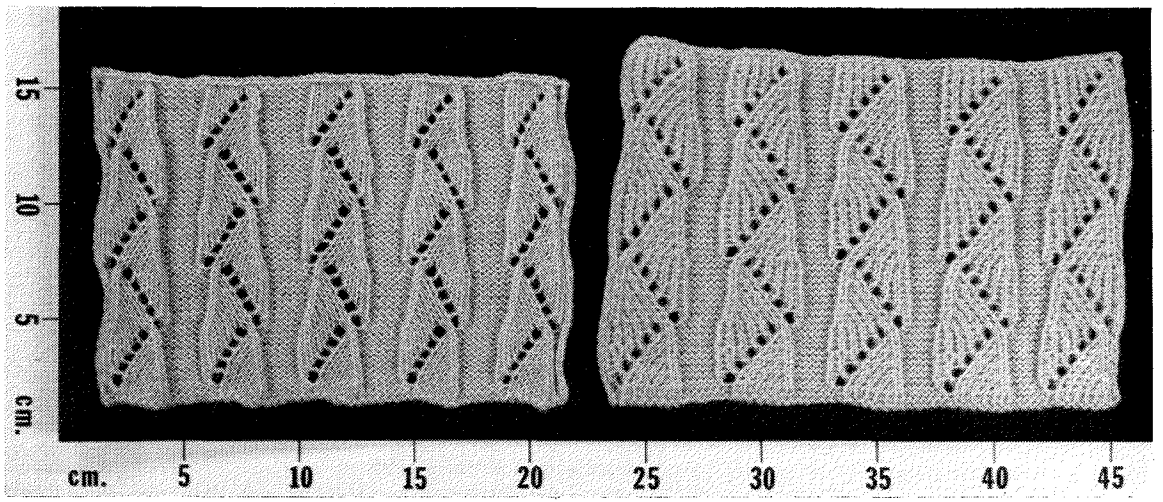


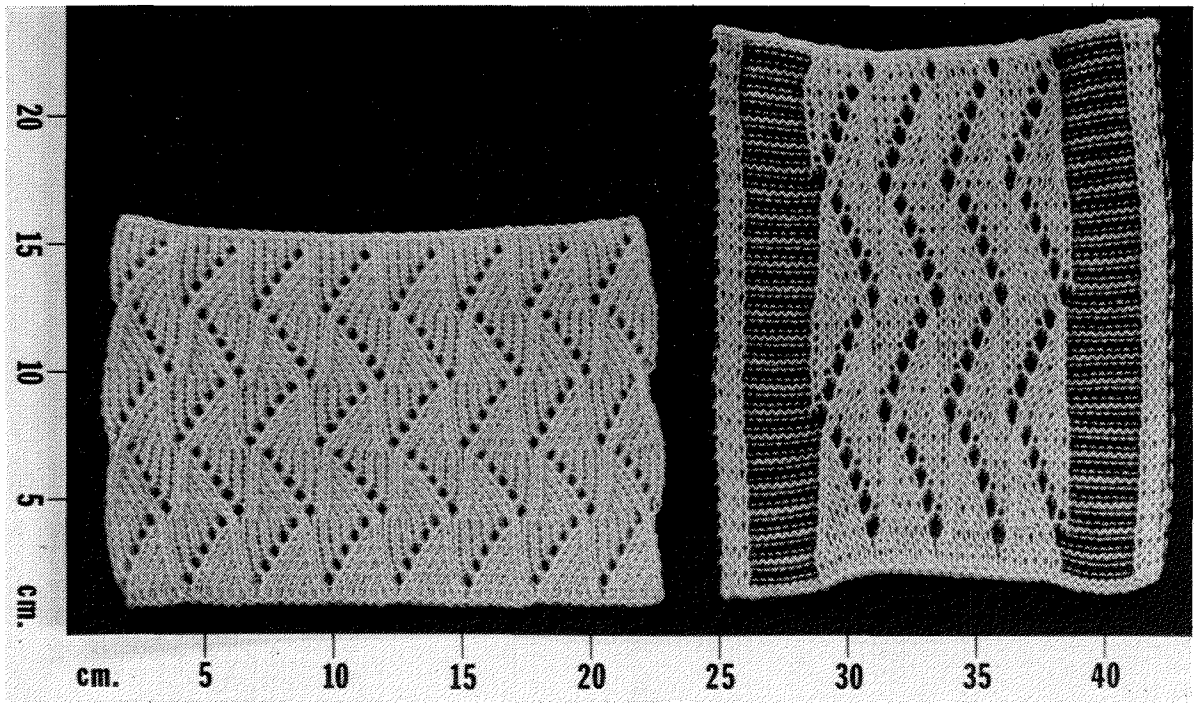
Comb stitch, punchcard for Singer/Studio.

Comb stitch.
Left. Comb stitch with fine lace setting, knitted single bed on Brother/Knitking. The fine lace setting on the L carriage causes incomplete transfer of the selected stitch. The stitch is transferred to the adjacent ndl as with N setting, but also remains on the original ndl, so the stitch is looped over both ndls. Because original ndl is not emptied, no eyelet will be formed. Usually the fine lace setting is used with single transfer patterns, to create textured patterns. This setting can also be used with multiple transfer patterns, if stitch size is made a little larger than normal, to create a solid fabric with a slightly embossed texture. This swatch was made the same way as swatch on the preceding page, but with the L carriage set to F throughout. Two knitted rows between transfers.
Right. Comb stitch, knitted partially with fine lace setting. Made single bed on Brother/Knitking. Another solid fabric made with fine lace setting; it works well with any multiple transfer pattern. In this swatch, unlike in the swatch at left, all stitches in the sequence are transferred normally with N setting, except the last stitch, which is transferred with F setting. This will give the fine lace texture and prevent an eyelet. To do this, the last two left transfers and/or the last two right transfers of each pattern row sequence are made with the L carr set on F (Marked with F on the punchcard diagram). Transfers prior to these are made with the carr set on N as usual. If there are only 1 or 2 transfers in any given pattern row, they all are made with the F setting. Two knit rows between transfers.

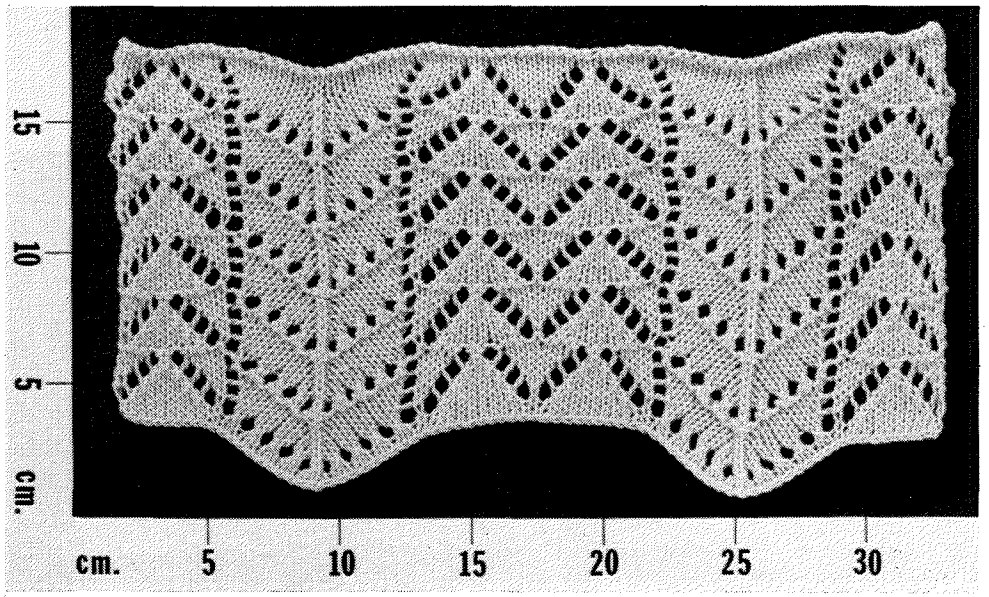


Left. Comb stitch, knitted double bed on Brother/Knitking. A knit/purl fabric. The ribs are made by transferring alternating repeats of 6 sts to the ribber: add a 7th ndl to each ribber group and hang a purl loop, with beds at half pitch. The fabric is then knitted as a wide rib of 6 sts on the MB alternated with 7 sts on the ribber. The ribber sts knit in stockinette. Two knit rows between transfers.
Right. Knitted double bed on Brother/Knitking. Embossed rib fabric, made the same way as in the swatch at left, except all ribber ndls are in WP instead of groups of 7 ndls. The embossed rib pattern is FNR; the areas between on the ribber are stockinette. The SS on the ribber should be large enough for the stockinette sts; the SS on the MB about half that. Two knit rows between transfers.

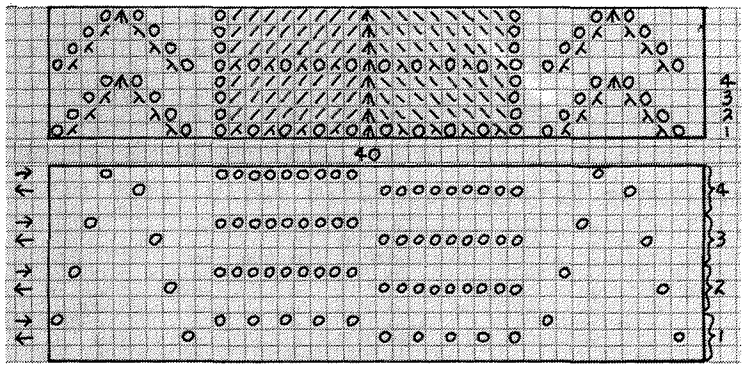




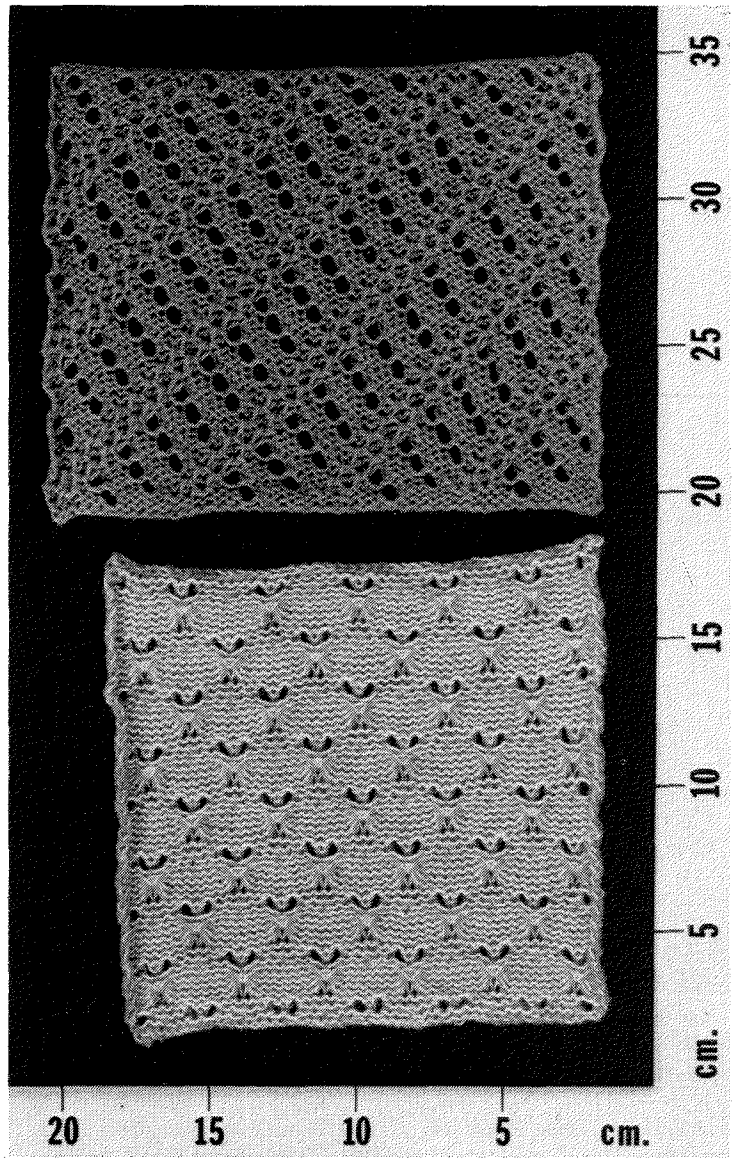
Left. Comb stitch, knitted double bed in FNR set-up on Brother/Knitking. Stitch size should be about that for FNR knitting. Two knit rows between transfers.
Right. Comb stitch, knitted double bed as an embossed fabric on Brother/Knitking. The pattern is knitted as an embossed panel on a two-color striper backing. To accommodate the color changer, turn the punchcard backward, and reverse the positions of the K and L carr. Ndls on the MB are in NWP either side of the panel. Set ribber carr to knit in both directions; on MB knit 2 rows with col 2 (dark) with both part buttons (ribber ndls knit), then 2 rows with col 1 (light) with the plain setting (all ndls knit), then proceed with transfer sequence. Stitch size on ribber should be large enough for the stockinette sts; the SS on the MB about half that.



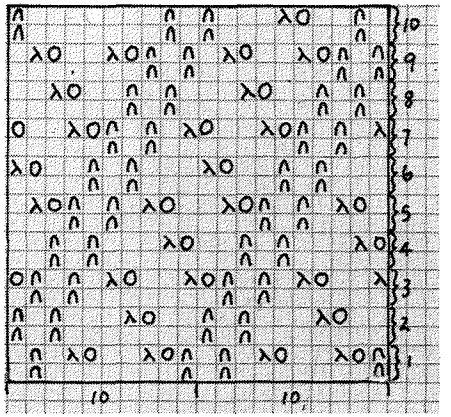
*Passap pattern: combination of single and multiple transfers. Made with a special punchcard. U-80 1 or 5. Deco 2, uncoupled. Set carriage GX/N. *Knit RC2 with carr and Deco. Two passes with Deco alone, R transfer. Two passes with Deco alone, L transfer.* In the illustrated swatch, the first 2 rows of each repeat knitted in garter stitch. Since no needle selection is required for knitting the stitches, the first punchcard row in each pattern row sequence (the blank rows) could be omitted to make a shorter card. In that case, the knitting sequence would be: *RC2 GX/N; 2 passes with Deco alone, R transfer; 2 passes with Deco alone, L transfer.**



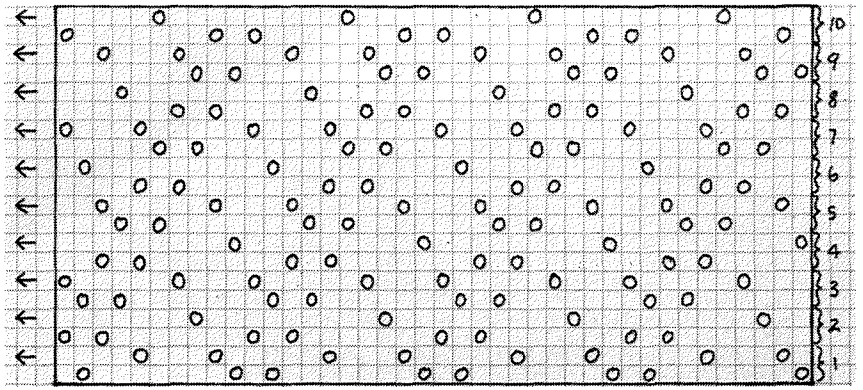
Passap pattern, design and punchcard.



Tuck stitch/stockinette with eyelets. Punchcards for Passap and Brother/ Knitking.
*Top. Diagonal pattern. Passap: made with a special punchcard. Two rows knit/tuck with transfers. U-80 1 or 5. Deco 2, uncoupled. Set carr GX/AX, left arrow key. *RC2 carr and Deco; 2 passes with Deco alone, R transfer.**
Brother/Knitking: one row knit/tuck, one row stockinette with transfers. Set K carr NL, left tuck button.
*Bottom. Honeybee pattern. Several rows knit/tuck with eyelets. Swatch knitted with plating. Both machines knit 2 rows stockinette, 4 rows knit/tuck, 2 rows stockinette with transfers. Passap: set carr GX/AX, left arrow key, Deco 2 uncoupled, U-80 1 or 5. *Two passes with Deco alone, R transfer; 2 passes with Deco alone, L transfer; RC8 carr and Deco.**
*Brother/Knitking: set K carr KC. *Transfer sequence with L carr. RC2 plain, RC6 both tuck buttons.*

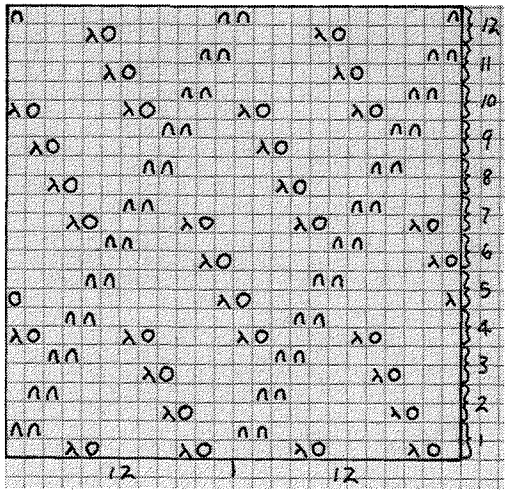


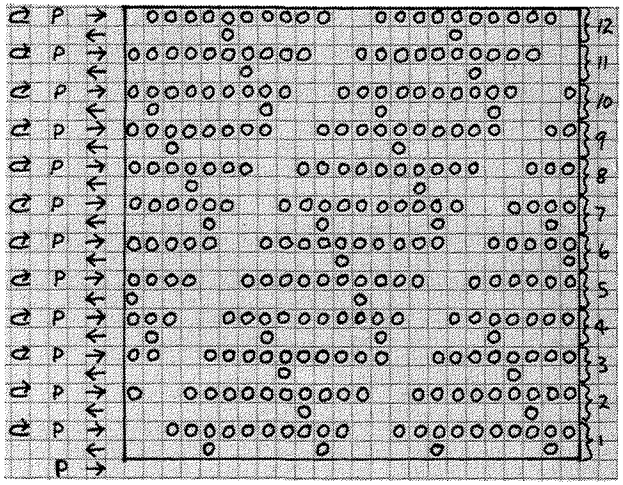
Design for diagonal pattern, Passap.



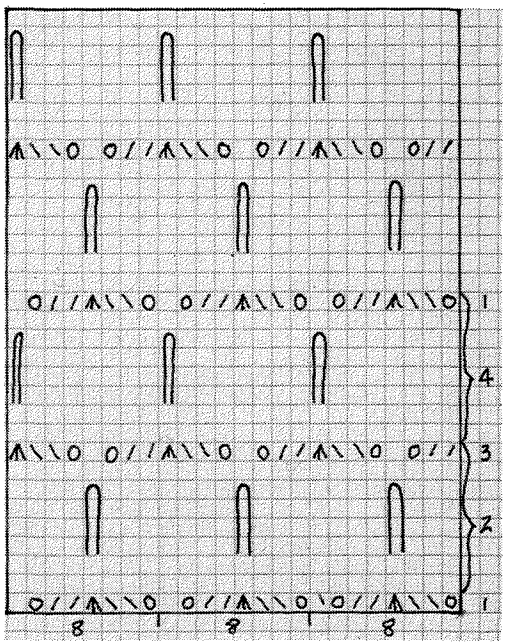
Punchcard for diagonal pattern, Passap.

The swatches in the remainder of this section illustrate special effects created by combining lateral transfers with other patterning.

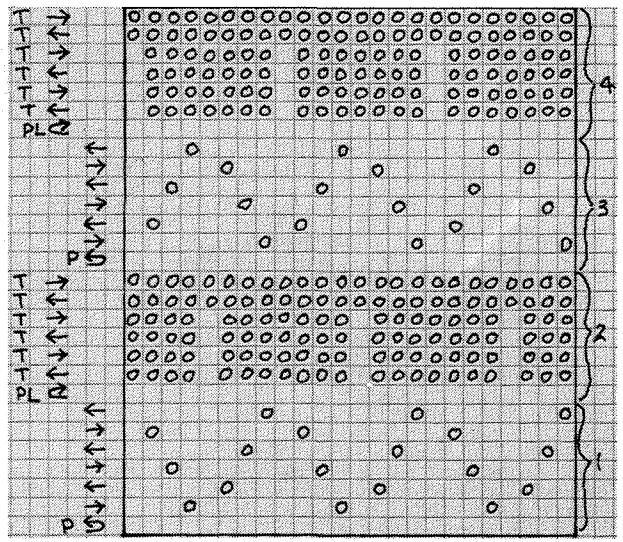




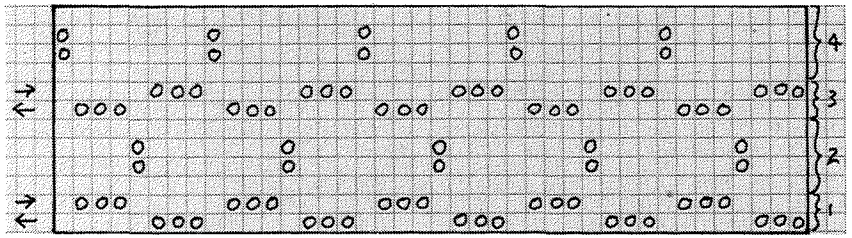
Diagonal pattern for Brother/Knitking, design and punchcard.



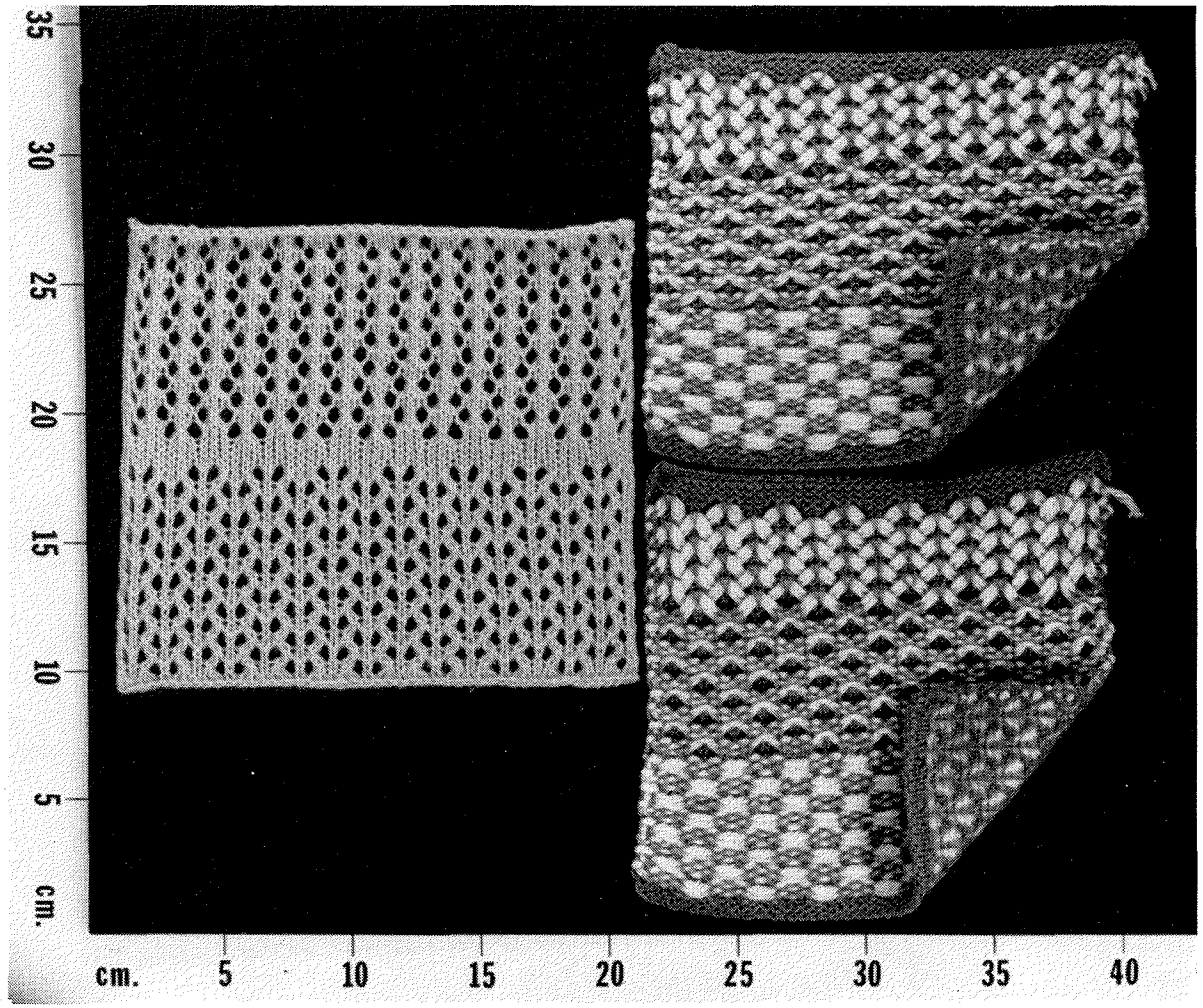
Design for honeybee pattern, Passap and Brother/Knitking.



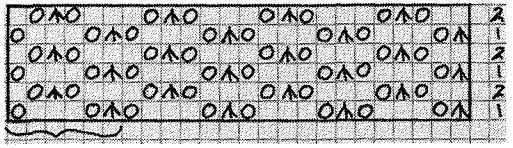
Punchcard for honeybee pattern, Passap.



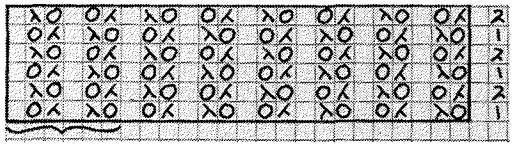
Punchcard for honeybee pattern, Brother/Knitking.



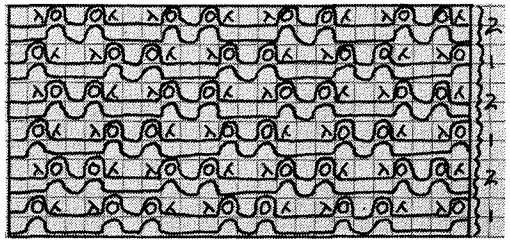
Weaving pattern. Punchcard for Brother/Knitking. A mesh pattern which can be knitted in two different designs, with or without weaving. If weaving is incorporated, yarn floats can be manipulated in various ways for patterning effects on purl side of fabric.
Left. Mesh patterns, knitted with the punchcard shown, without weaving. The bottom portion shows mesh knitted with the punchcard oriented in the reader in the usual fashion. For the top portion, the punchcard was turned backward in the reader to reverse left and right transfers on the card. Compare the two graphed designs and note the changes in direction of transfers. Both are knitted exactly the same way: K carr KC, plain.
Bottom right and top right. Weaving incorporated with the meshes. Set K carr KC, plain; use weaving yarn simultaneously with main yarn on the two knit rows (see Weaving chapter for technique). Bottom portions of both swatches knitted straight as punched. To knit center portions, hook the 2 floats from below on the central ndl above, after the transfers, just prior to knitting the next two rows. On the top portions, hook the 2 floats from below on the central ndl above after *the next two rows have been knitted and transferred.*

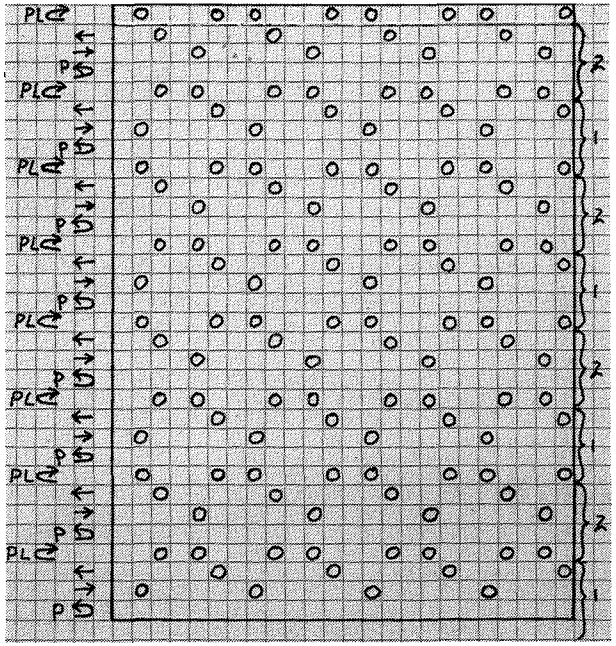


Mesh without weaving. Design for the top portion of the swatch at left in the photo.



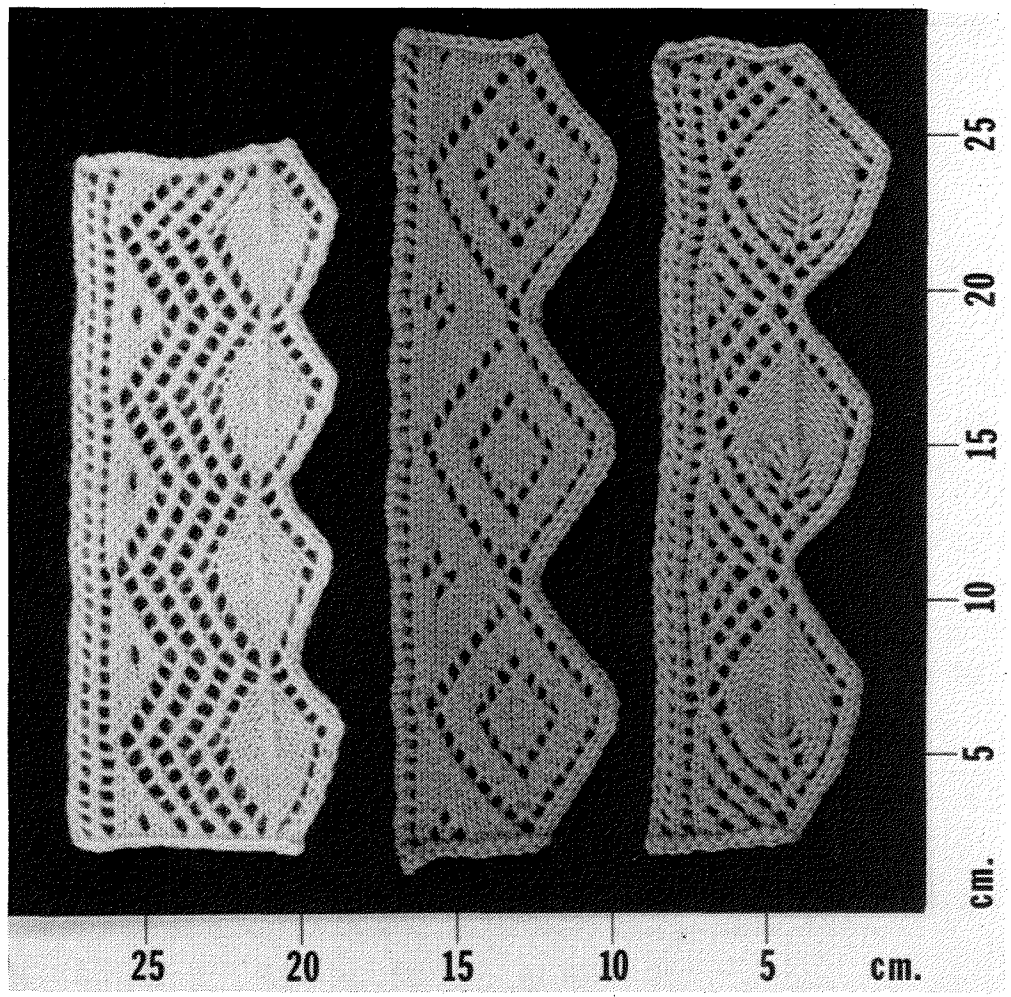
Mesh without weaving. Design for the bottom portion of the swatch at left in the photo.



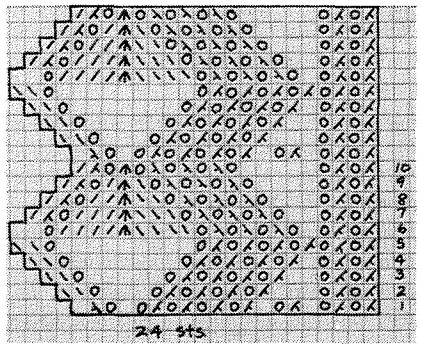


Mesh with weaving. Design and punchcard for all of the swatches shown in the photo.

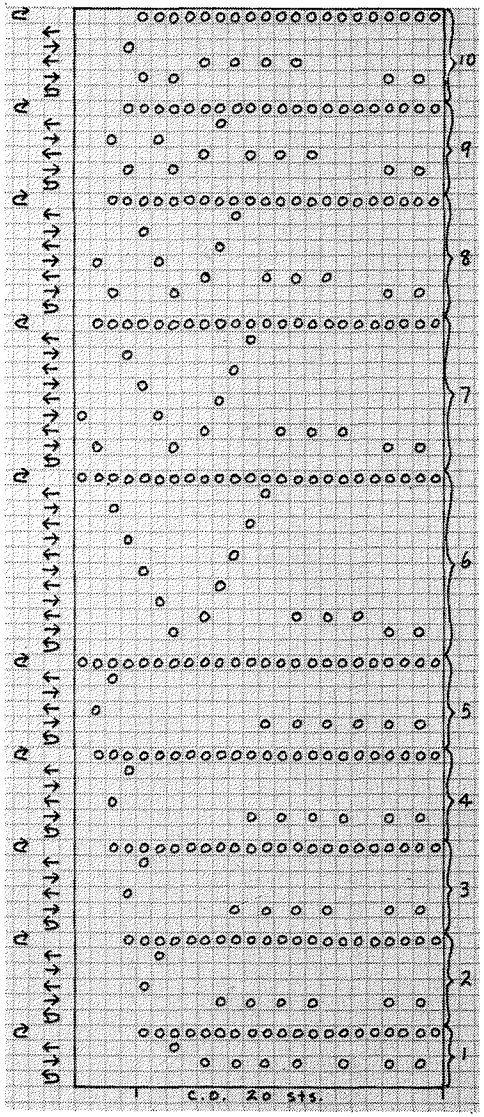
The following two photos show patterns with shaped selvedges. Edgings and medallion for Passap, Brother/Knitking and Singer/Studio, made by punchcard. Before knitting these patterns, remove the non-selection mechanism under the L carr on Brother/Knitking, and remove the two orange end pins from the needle bed on Singer/Studio, so selvedge ndls can be selected by the punchcard when required. To obtain a firmer selvedge on the heading of all edgings, slip the first stitch, EOR.



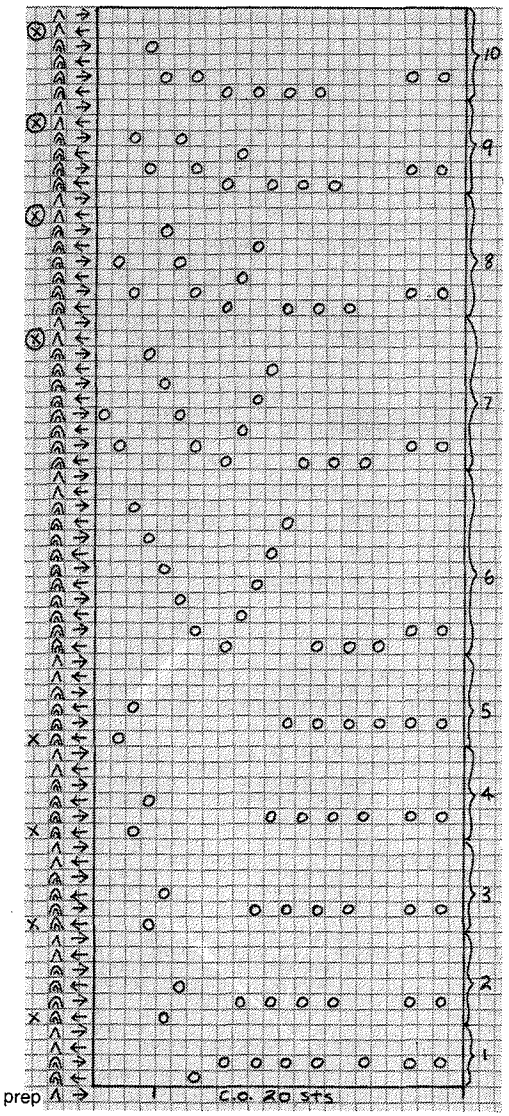
Left. 24-stitch edging, Brother/Knitking and Singer/Studio: cast on 20 sts, using ndls 8-0-12, knit 2 rows on Brother/Knitking (carr end R); one row on Singer/Studio (carr end L).
Brother/Knitking: put 4 more ndls at L in WP (12-0-12). Set K carr KC, left and right part buttons. Start card by knitting 1 row L to R with L carr, set ER rotation, and continue.
Singer/Studio: memorize first row by knitting 1 row L to R, set to ER rotation, and continue. On rows marked X, *put 1 ndl at L in WP before knitting the row. On rows marked with a circled* X, *put 1 ndl at L in NWP before knitting the row.*
*Center and right. 20-stitch edgings, for Passap; made with a special punchcard. Both edgings will fit on same punchcard. Position the card reader so that the edging you wish to use is directly under ndls in WP. Set carr to GX/BX, no arrow key. Deco 2, uncoupled. U-80 1 or 5. Cast on 13 sts; put remaining ndls and pushers in WP at right. *2 passes with Deco alone, R transfer; 2 passes with Deco alone, L transfer; RC2 carr and Deco.**



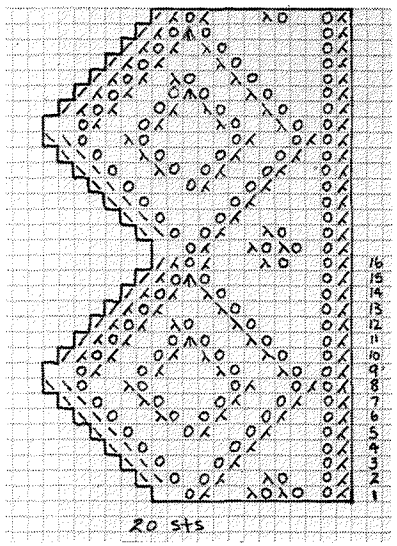
Design for 24-stitch edging, Brother/Knitking and Singer/Studio.

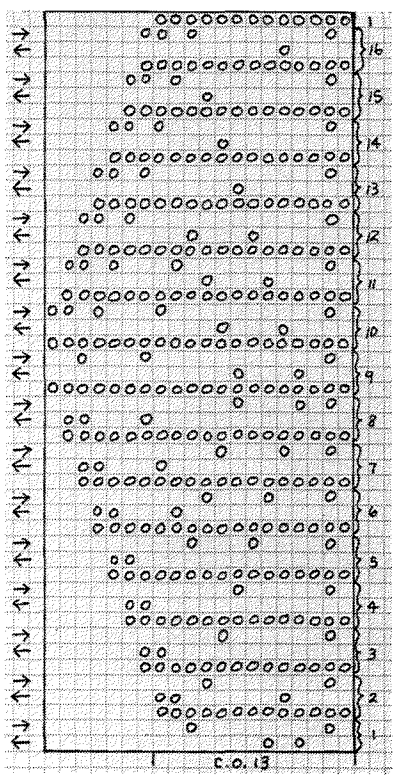


Punchcard for 24-stitch edging, Brother/Knitking.

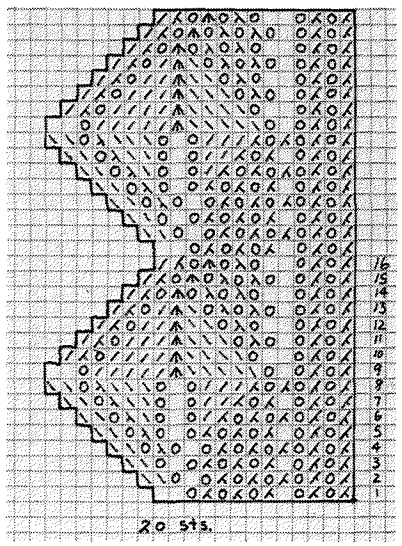


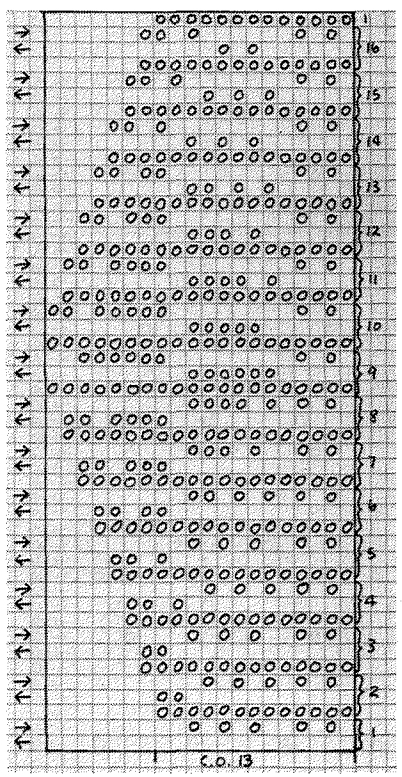
Punchcard for 24-stitch edging, Singer/Studio.



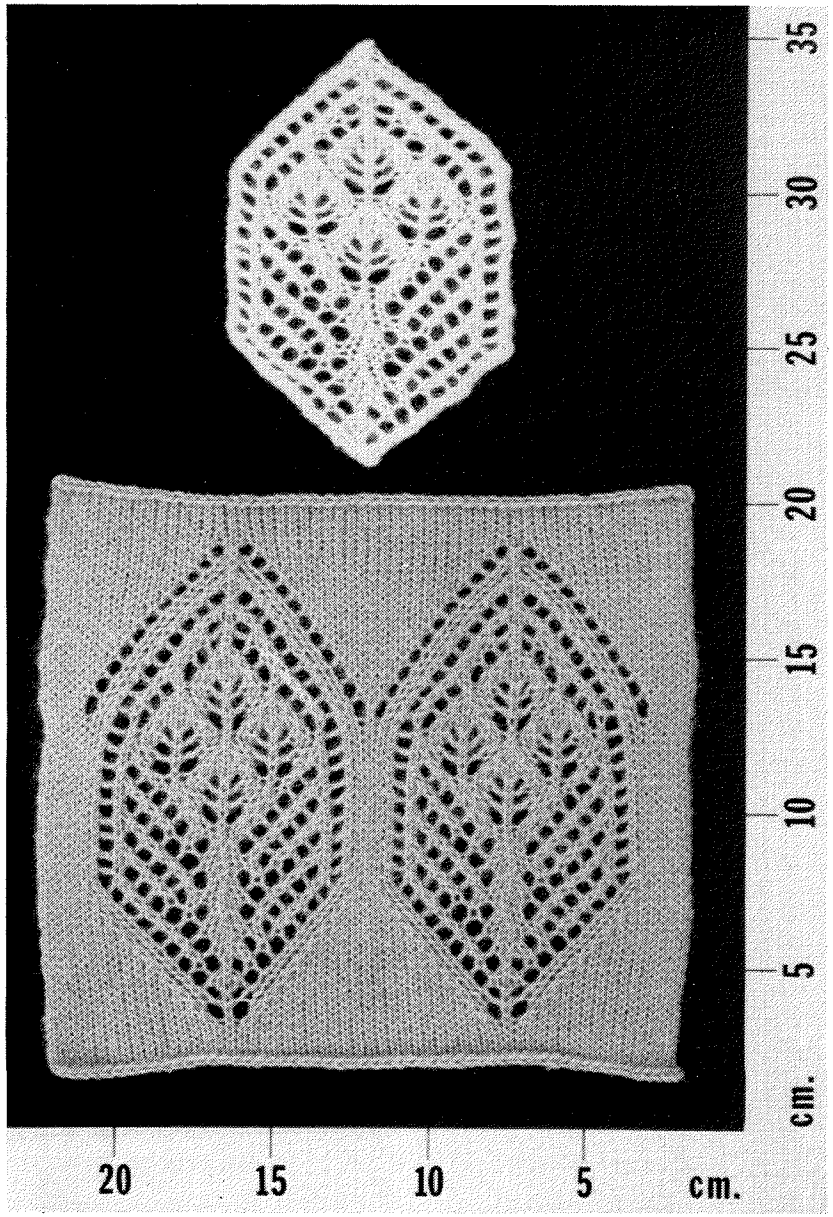


Design and punchcard for 20-stitch edging, Passap. Center swatch in photo.

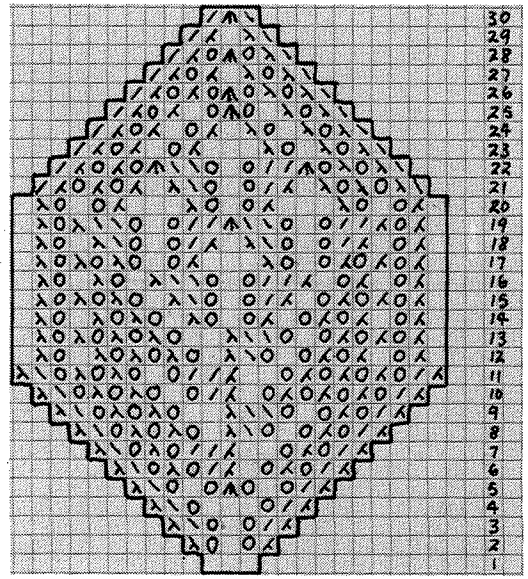




Design and punchcard for 20-stitch edging, Passap. At right in photo.

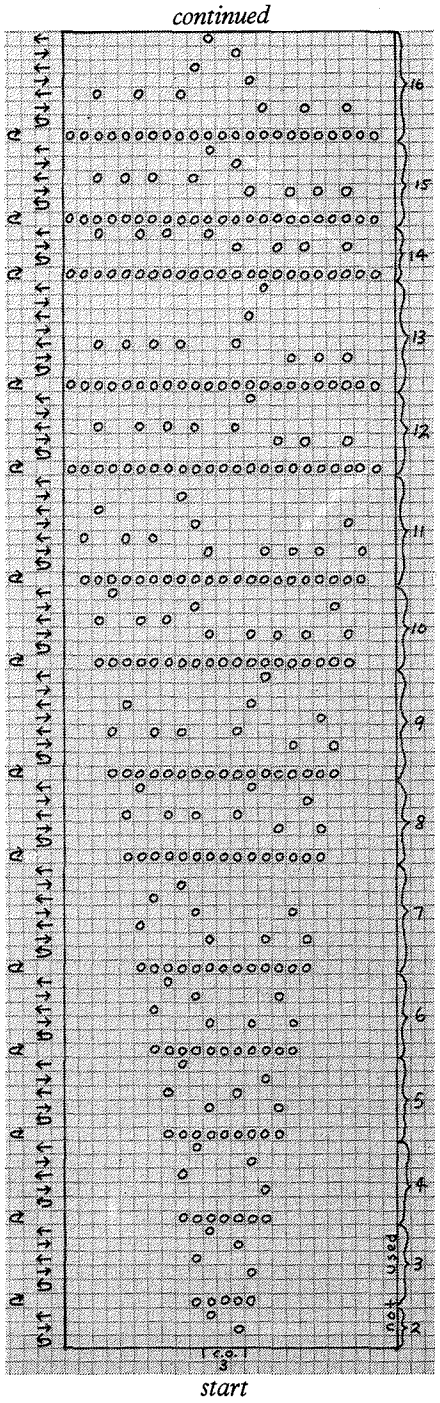


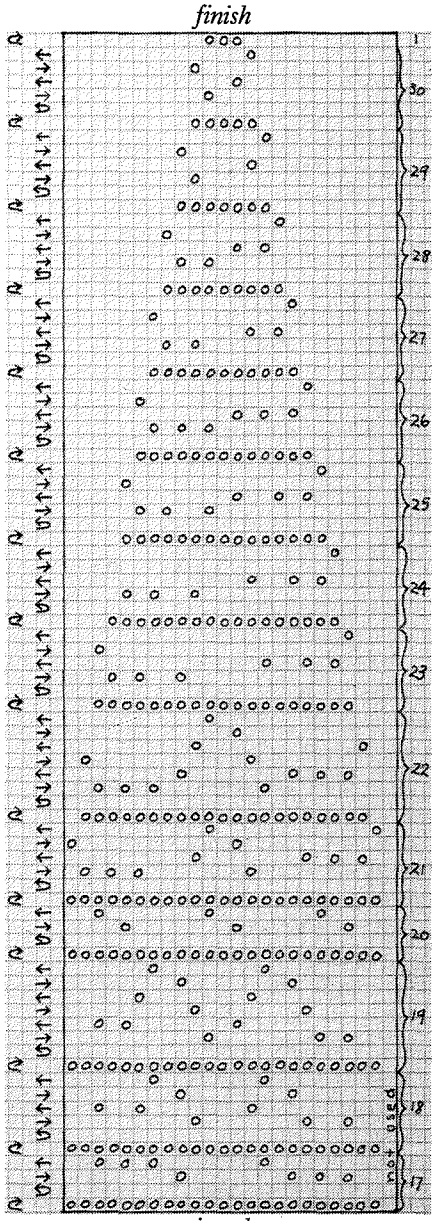
Medallion pattern for Brother/Knitking and Singer/Studio. Knit as a medallion, as an all-over pattern, or as an isolated motif. Pattern can also be knitted as an embossed design on Brother/Knitking (see Embossing chapter).
Top. Medallion. Note that the extreme right column is not used; the medallion is 23 sts wide.
Both machines: Knit pattern same as for edgings. Cast on (use ndls 2-0-1).
Brother/Knitking: put remaining ndls in WP (12-0-11) and proceed as above.
Singer/Studio: add and subtract 1 ndl each side on the X and circled X rows, the same as with the edgings.
Bottom. All-over medallion pattern. At the end of the repeat, make an extra double decrease to finish off the tip. This can be done manually.
Brother/Knitking: set carr to KC, plain.
Singer/Studio: omit X markings.



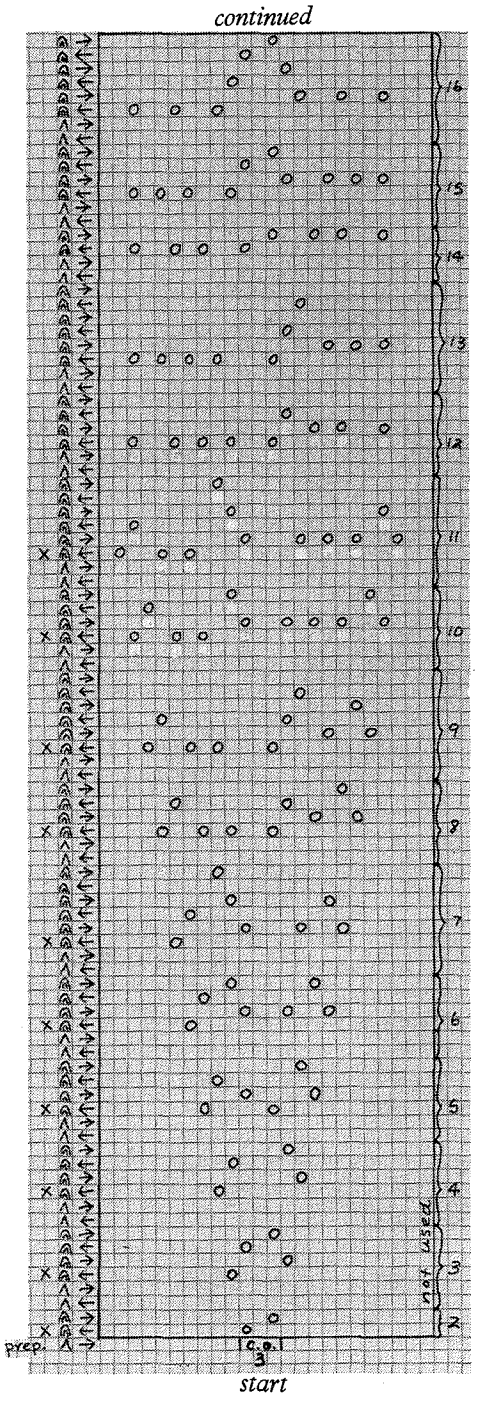
23 sts

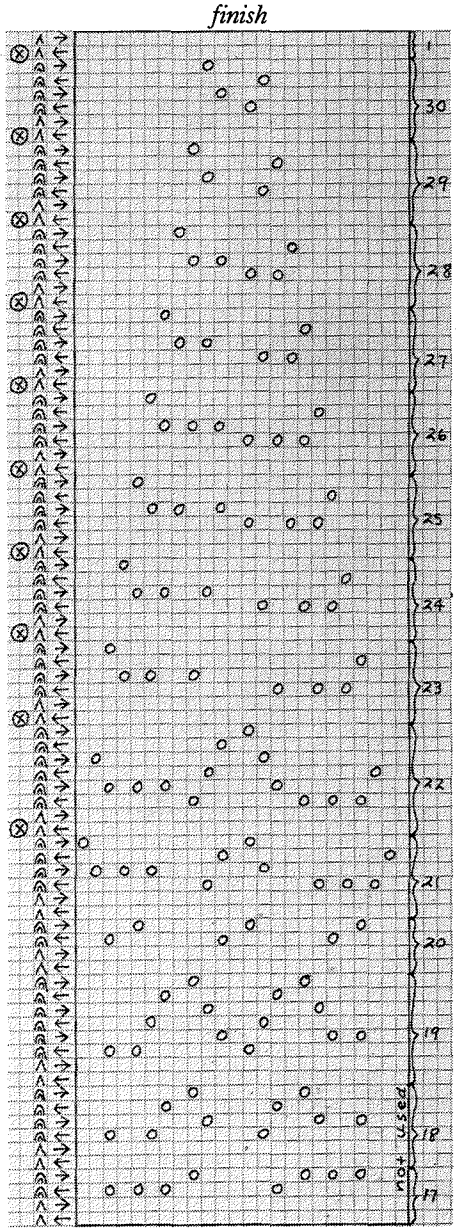
Design for medallion pattern, Brother/Knitking and Singer/Studio.



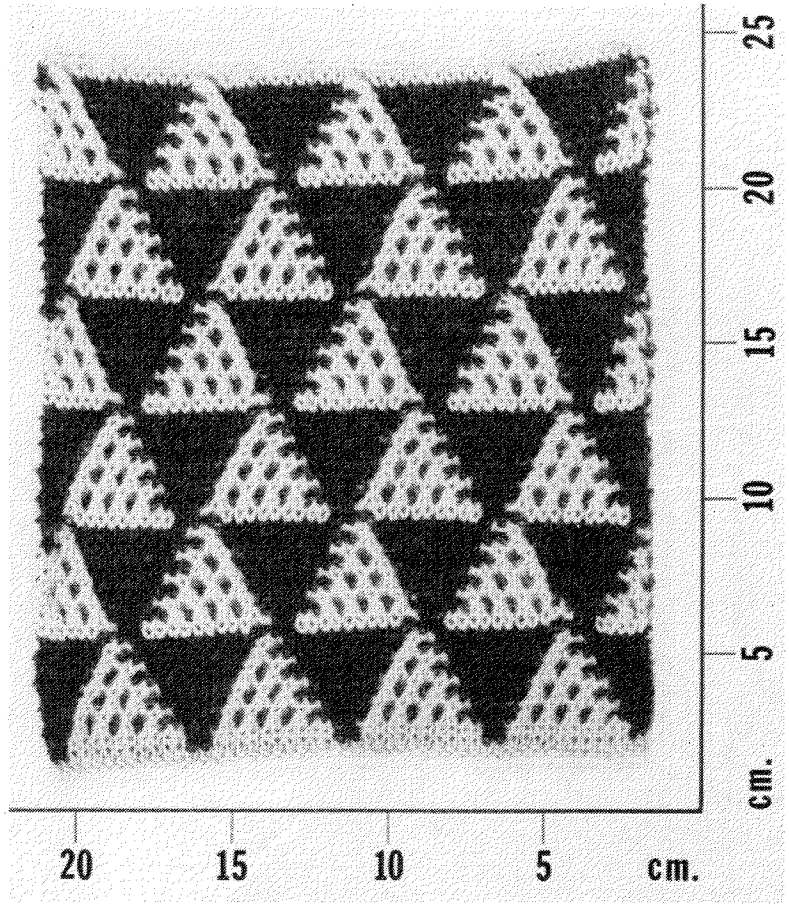


Medallion punchcard, Brother/Knitking.

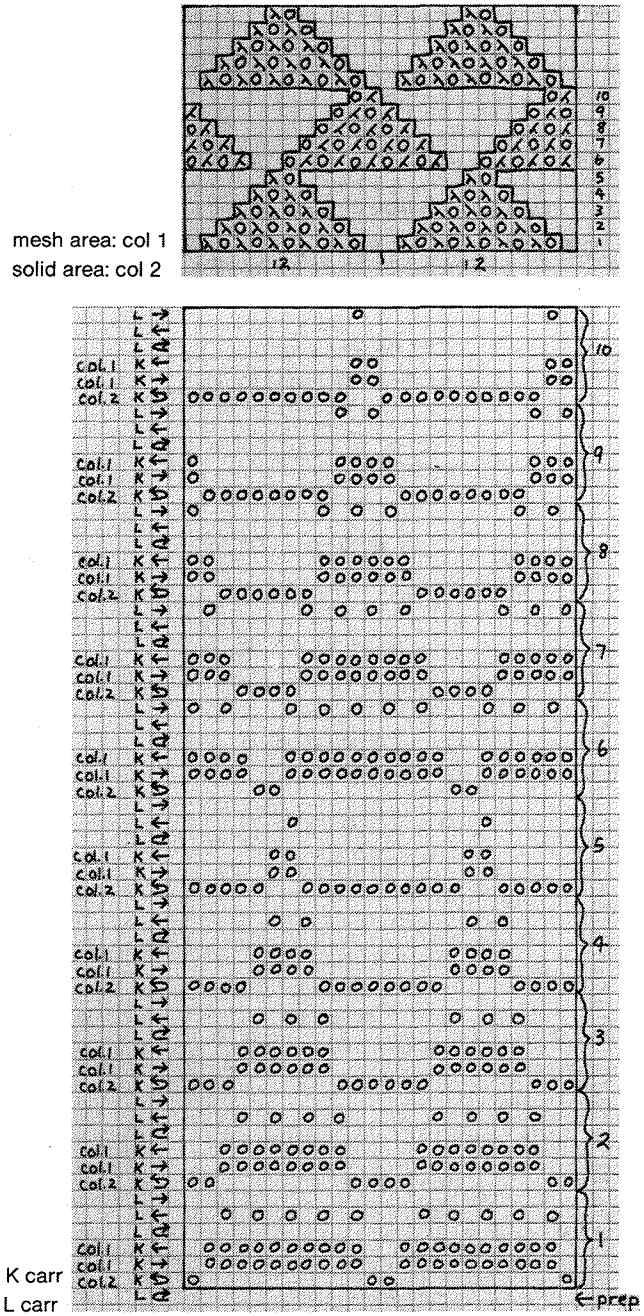




Medallion punchcard, Singer/Studio.



*Two-color rib jacquard with striper backing and mesh pattern; Brother/ Knitking. Start with K carr at left; L carr at right. Set K carr: KC, L and R part buttons; ribber carr to knit both directions. *Knit RC2 each color; transfer.* For more information on rib jacquard knitting, see Chapter 1.*



Design and punchcard, two-color jacquard pattern for Brother/Knitking.

HOW TO KNIT LATERAL TRANSFER LACE

Manual transfer on all machines.

Use a single or multiple decker transfer tool (whichever is more convenient for the pattern) to move stitches laterally to needles on the same bed as directed for each pattern row on the design graph. Leave empty needles in WP unless directed otherwise. Usually two rows are knitted in stockinette across all needles between transfers. To make variations in the stockinette fabric, purl stitches can be incorporated by setting up ribs when casting on, the stockinette or rib stitches can be plated, or tuck, jacquard, or weaving can be included with the lace by using an appropriate punchcard to knit two or more rows in pattern between transfer rows. You might also knit the pattern in FNR or Long Stitch, with transfers on the main bed only, or incorporate some rows of garter stitch with stockinette knitting.

Brother/Knitking: automatic transfer with a punchcard.

The L carriage and the K carriage are used together on this machine. The L carriage does all the physical transferring of stitches, and the K carriage holds the yarn and knits the stitches.

The L carriage is automatically connected to the timing belt each time it slides off the extension rail onto the needle bed. It reads and rotates the punchcard, and the punchcard selects the needles from which stitches will be transferred. When the L carriage moves left to right, it transfers the stitches from all selected needles one needle to the right; moved right to left, all transfers are to the left by one needle. The L carriage can transfer stitches from single selected needles only; that is, at least one needle each side of the selected needle must be in working position. It cannot transfer stitches from a group of adjacent selected needles all at once, as is necessary in multiple transfer patterns. For these patterns, it is necessary to punch several rows so the L carriage can transfer the stitches one at a time, beginning with the decrease and ending with the eyelet.

In stockinette lace patterns, the K carriage is not connected to the belt (change knob set NL), but knits 2 rows across all needles after all the transfers for each pattern row are completed by the L carriage. Tuck patterns, weaving, and jacquard designs can be incorporated with lace knitting if some rows are punched on the card for pattern needle selection, between the transfer sequences for the L carriage. This means there must be special cam settings on the K carriage, and/or connecting the K carriage to the belt (change knob set KC). By using the ribber and special techniques, you can also incorporate double bed knit/purl and embossed designs with lace knitting.

For stockinette lace patterns knitted in one color, the card is punched so that the L carriage begins and ends at the left side, and the K carriage begins and ends at the right side. The preparation row is left to right with the L carriage. Unlock the card and set to every row rotation when the carriage is at the right. There must be separate punched rows on the punchcard for left transfers and right transfers, a blank row at the start of each sequence for a preparation row, and sometimes an extra blank row at the end of each sequence to get the lace carriage back to the left side.

With this in mind, compare the pattern for alternating vertical trellis mesh (a single transfer pattern) with its punchcard. The arrows and notations are the same as those used in the instruction book for the machine. Review those instructions if you need to. Here the notations are shown next to their respective rows. Move them up eight rows when you mark your card. The blank preparation row to start each sequence is marked with a P. Remember, where there is a notation for the K carriage on the same row as a P row for the L carriage, the K carriage always knits first.

Now compare the pattern for comb stitch, which is a multiple transfer pattern, with its punchcard. Note that each stitch of the multiple transfer must be transferred separately, and requires its own punched row on the card. The stitch that transfers to form the decrease is first, followed by the others in turn until the last stitch, which will make the eyelet, is transferred.

In two-color knitting with the color changer, the L carriage begins and ends at the right side, and the K carriage begins and ends at the left. The preparation row is right to left with the L carriage; unlock the card and set to every row rotation with the carriage at left. You must also turn the punchcard over and insert it backwards into the reader, or punch a card especially for two colors.

The diagonal pattern illustrates lace combined with tuck patterning. With this kind of card, selection is limited to one row of tuck pattern followed by one row of stockinette, alternating with a transfer sequence. Selection for the tuck pattern is made by the L carriage throughout. Set the K carriage: NL, left tuck button.

To examine the pattern more closely, the first of the two stockinette rows has a pair of tuck stitches, which means that the L carriage, on its last row back to the left side can select needles for the K carriage, which follows with its two rows. The first of the two rows will knit/tuck the selection from right to left, and since the card won't rotate (NL), there will be no selection for the second row; hence the cam is set to knit all stitches plain from left to right. When the L carriage begins again, it will rotate the card and select the needles for right to left transfer. On its return, it will transfer these stitches and at the same time again select needles for the K carriage. This particular pattern has left transfers only; if it had right transfers as well, extra rows would have to be added to the transfer sequence to accommodate them. There are two reasons why the consistent left transfers do not cause this fabric to bias. First, the eyelets are spaced some distance apart and are on different needles each row. Second, the tuck stitches, which move on the opposite diagonal, help absorb bias tendency.

The honeybee, weaving, edgings, medallion, and two-color jacquard patterns are examples of lace with other patterning, such as slip, tuck, weaving, and jacquards, with the K carriage set this time to KC.

With these kinds of cards, the number of rows for other patterning is unlimited, since the K carriage is also connected to the card reader (KC) with cams set for slip or tuck. The rows for the K carriage are punched between the transfer sequences for the L carriage, the same as in the preceding diagonal pattern. There is one important point to remember when designing this kind of card: on the Brother/Knitking punchcard machines the card does not rotate to the next row when switching from one carriage to the other, so the same needle selection will occur twice. Thus, when the L carriage selects needles for the K carriage on its last pass, the K carriage will knit the selection, then the same selection will recur for the K carriage on its return pass—this is the reason for only one punched row for the K carriage on the edging, medallion, and weaving patterns illustrated, and for

the color 2 rows on the jacquard card. Whenever the K carr is set to KC, *it is very important to move one carriage completely off the belt onto the extension rail before starting the other carriage,* to avoid damage to the belt and needle selector.

Brother/Knitking: procedure for knitting double bed patterns with the L Carriage.

Remove the brushes from the L carriage, being careful not to lose the washers underneath. Before casting on, check the ribber to be sure the pitch, spacing, and height are in proper adjustment. Use the ribber sinker arm on the coupled carriages and knit with the ribber in normal position. When ready to transfer, first drop the ribber slightly to the first position, then use the stopper bar from a garter bar on the ribber needles to hold the needle butts down during transfer. If necessary, adjust the width of the bar with a screwdriver. During the transfer, you may need to pull down on the cast-on comb with your other hand. It is also possible to knit rows with the ribber in the dropped position.

Brother/Knitking: procedure for using the L carriage with manual needle selection.

If there is no punchcard in the reader: place the L carriage on the appropriate side of the needle bed (pushing the K carr out of the way if necessary), select individual needles to D position, and move the carriage across for transfer. All working needles will move to D position following the L carriage. If this is a nuisance, insert a card in the reader and lock it on an unpunched row.

To transfer during pattern knitting: lock the punchcard and move selected needles back to B position. Select needles for transfer and move the L carriage across. The same pattern needles from the punchcard will again be selected following the L carriage. Unlock the card and continue with the K carriage.

Singer/Studio: automatic transfer with a punchcard

On this machine, the lace carriage is connected to the punchcard reader by the side levers, and does all the transferring of stitches as well as all the knitting. The main carriage is not used at all. Holes are punched in the card for needle selection for transfer. When the carriage moves left to right, selected needles are transferred to the right by one needle, and vice versa. The lace carriage cannot transfer adjacent selected needles as a group all at once, as would be necessary for a multiple transfer pattern, therefore several rows must be punched on the card so each stitch in the group will move over in turn, beginning with the decrease and ending with the eyelet.

There are two cam settings on the lace carriage, one for single transfer patterns and the other for multiple transfer patterns. For single transfer patterns, the cam lever is in the forward position, set for plain lace. Transfer and knitting occur simultaneously, with each pass of the carriage. The transfer is first, followed by the knitting. For multiple transfer patterns, the cam lever is in the side position, set for fashion lace. The yarn is removed from the feeder so the lace carriage can move back and forth to accomplish the complete transfer sequence without knitting any rows. The yarn is then replaced in the feeder and the cam changed to the forward position to knit two more rows before the next transfer sequence.

Cards are usually punched so the lace carriage will start at the left side of the machine, to knit a preparation row, and the first transfers will be right to left. In multiple transfer patterns, the yarn is placed in and out of the feeder with the carriage at the right. If you wish to use the color changer to hold other ends of yarn for striping, it will be more convenient to reverse the carriage positions, and turn the card backward in the reader.

The lace carriage knits only in stockinette. It has no slip, tuck, or jacquard cam settings, or weaving brushes. In theory, it is possible to use the main carriage and the lace carriage together, punching spaces on the card so that other kinds of knitting, such as tuck and jacquard, can be incorporated with the lace. In practice, however, it doesn't work well; since there are no extension rails, the width of the fabric is limited to the 24 stitches in the center of the bed. Nor can the lace carriage be used with the ribber, which precludes the knitting of knit/purl or embossed fabrics with the lace carriage.

In single transfer patterns made with the plain lace cam setting, there will not be two rows of stockinette knitted consistently between transfers, as is assumed in the graphed designs in this section. Since the carriage was designed to knit a row after each transfer, both left and right transfers cannot be put on the same knitted row with this setting. In most figured and bilaterally symmetrical geometric patterns involving single transfers, it makes little difference to the finished fabric that the left and right transfers are on alternating rows rather than the same row. Although the same patterns made with the fashion lace setting will be completely balanced and symmetrical, it is much slower to knit them this way.

The photographs of the two mesh patterns, alternating vertical trellis mesh and square mesh, illustrate how pattern variations can be created with the plain lace setting. In order to knit the two meshes as shown in the graphed design, both must be made with the fashion lace setting, as shown in the punchcard diagrams. The notations at the left of the punchcard diagrams for these fabrics indicate the setting used for each row; move them up six rows when marking the card itself. However, in alternating vertical trellis mesh, if the punchcard for Brother/Knitking is used with the plain lace setting throughout, a new mesh pattern will be made with three knitted rows between transfers instead of two. Likewise, in square mesh, if the card is knitted with the plain lace setting throughout, there will be one row alternated with three rows between transfers, which also produces a new pattern.

The two mesh patterns given with the weaving pattern can also be knitted with the plain lace setting. Knitting the card for Brother/Knitking as shown, or turned backwards, will produce an interesting pattern. For a version of the two meshes more like that made on Brother/Knitking, punch rows 2, 3, 6, 7 only, repeating the four rows.

The three multiple transfer patterns, comb stitch, edging, and medallion, are knitted in the traditional way with the fashion lace setting for the transfers. Note that the edging and medallion have shaped selvedges; needles must be added and subtracted at the indicated rows *before* the row is knitted.

Singer/Studio: procedure for using the lace carriage with manual needle selection.

Insert a card in the reader and lock it on an unpunched row. Push side levers back. Set cam to either plain lace, with yarn; or fashion lace, without yarn. Bring selected needles to C position *with the stitch*

on the latch. Pass the carriage across to transfer. All ndls will return to B position after the transfer.

The transfer can be touchy and requires some practice. If the needle is brought out too far, it will move to D position and jam the carriage. If it is not brought out far enough, it will return to B position without transferring.

Passap and Superba: automatic transfer.

With their cross bed transfer carriages, the U-80 and garter carriage, these machines can make lateral transfer lace patterns by the same method used by industrial machines. In a stockinette fabric, all stitches which are to transfer to the right (or left) on a pattern row are first transferred, all at once, to the opposite bed. Then the beds are racked by one needle in the appropriate direction, and the stitches are transferred back to the main bed. Racking causes the transferred stitches to be moved either left or right by one needle, to create the eyelets and decreases. Both multiple and single transfer patterns can be knitted this way, since the cross bed carriages can transfer both single and adjacent selected needles all at once. All the knitting is done on the main bed. The needles of the second bed are all in working position across the knitting width, and are used only to hold stitches during transfer, not to knit them. There are always two successive transfers: from the main bed to the second bed, then, after racking left or right one needle, from the second bed back to the main bed. Many simple patterns and meshes can be created on both machines without using punchcards, such as vertical trellis mesh, bias checks, bias zigzag, and waved ribbon for Passap.

If you haven't already done so, we suggest you study the chart in Reference Chapter 5, which shows the capabilities of the U-80 and garter carriage.

Left and right transfers for lateral transfer lace patterns are made in a slightly different way from those for ordinary cross bed transfers, and are as follows.

On Passap, knitting is done on the front bed with beds in transfer or quarter pitch (9 o'clock) position. First transfer: from front to back as usual, without racking. Second transfer: for a left transfer, rack one needle to left (9 o'clock around to 9 o'clock), transfer back to front. For a right transfer, rack one needle to right (9 o'clock around to 9 o'clock), transfer back to front.

On Superba, knitting is done on the back bed with beds in transfer or quarter pitch position. (Place beds in full pitch, then pull transfer lever forward.) First transfer: from back to front, no racking. Second transfer: for left transfer, rack one needle left, transfer front to back. For right transfer, rack one needle right, transfer front to back.

On both machines, after a left or right transfer is completed, the beds are in position to knit the next rows and transfer the next group of stitches. It is not necessary to rack back to starting position, but it is a good idea to put some extra needles in working position at each end of the working position needles of the second bed, to accommodate multiple racks in the same direction.The number of needles needed and the starting racking position depend on the number of successive transfers which will occur in the same direction. It is of no real concern, since the beds can be racked anywhere at any time other than during a transfer sequence. On Passap, if pushers are used to select needles for front to back transfers (U-80 setting 1 or 5), it's a convenience to put pushers under the back bed needles in working position too, so back to front transfers can be made without changing the U-80 setting.

Passap: lateral transfer lace made with a punchcard

The following does not apply to Superba. Because needle selection for transfer is governed by the presence or absence of a needle on the opposite bed to receive the stitch, pattern cards cannot be used to select needles for transfer on Superba.

The simplest cards to use on Passap are those where pushers in working position for needle selection are handled by the U-80 only. Many of the jacquard punchcards, such as jacquard Pattern 1 and Pattern 2 are very appropriate for this kind of lacemaking, as are many of the designs produced by Passap. The main carriage, set on N, has the yarn, knits stockinette across all needles and is not concerned with needle selection although the Deco is set on 2. The punched holes on the card will indicate needles to be selected for transfer, via the pushers. All the transfers can be in the same direction on each pattern row, or in alternate directions on alternate rows to prevent bias. The two carriages alternate in their movements; first the main carriage knits two rows, then the U-80, set on 1 or 5, moves stitches to other needles for the pattern.

More complex punchcards can be designed so that extra rows are punched for needle selection by the main carriage between the rows punched for needle selection by the U-80. With such cards, tuck patterns can be incorporated with lace patterns, as can slip stitches, lace edgings, medallions, and jersey jacquard patterns with lace textures.

Special cards can also be punched to include both left and right transfers on the same row. In lateral transfer lace made with jacquard punchcards that have a 1x1 background, such as jacquard Patterns 1 and 2, the transfers should alternate left and right on successive pattern tows to make a mesh background like that in alternating vertical trellis mesh. These cards, however, confine the pattern to either left or right transfers across the entire row, which limits the range of patterning possibilities. A specially punched card, illustrated by the Passap pattern, enables making both left and right transfers on the same row, thus opening up the whole world of traditional handknitting lace patterns. The pattern has both multiple and single transfers, and requires three punched rows on the card for each pattern row. The first row is for the main carriage to knit two rows of stockinette, slip, or tuck stitches. The second row is for all stitches which are to be transferred left by the U-80. The third row is for all stitches which are to be transferred right by the U-80.

The actual technique for making left and right transfers is detailed in the Automatic Transfer section above. Don't forget, when the card is turned and inserted into the reader, all the left transfer markings are now right transfer markings, and vice versa. This will not affect the pattern, except to reverse it.

To combine other kinds of knitting with lace, just expand the first of the three punchcard rows in each sequence, to as many rows as are needed, with punched holes and appropriate cam settings on the main carriage to incorporate other kinds of stitches. The photographs illustrate some examples.

LACE MADE BY CROSS BED TRANSFER OF STITCHES

This fabric is also known as *shadow lace* or *transfer lace*, and is an embossed lace produced by a double bed technique. The main fabric is knitted on one bed; the pattern stitches which create the eyelets are knitted on the opposite bed, usually for two or four rows, then transferred to adjacent needles on the main fabric. Eyelets are created by the first row of knitting on empty pattern needles; successive rows on the same needles create ribs, which form the linear elements of the pattern. The solid portions of the fabric are made by the stockinette stitches of the main fabric on the opposite bed.

Transferring across beds can be done manually with decker tools, or by using one of the cross bed transfer carriages. Descriptions of these carriages and their operation are found in Reference Chapter 5.

Since this is an embossing technique, the patterning often has a slightly raised appearance, depending on the yarn and stitch size used. The size and shape of the eyelets will be governed by the type of stitch in the patterning and the frequency of transfer.

Punchcards can be used, but this lace technique also lends itself to manual patterning. Various kinds of meshes can be made easily by coupling racking with a simple needle set-up, or by punchcard, whichever you find most convenient for your machine and transfer carriage. A 1x1 selection is shown in the swatches, but other set-ups are possible too, such as 2x1 or 3x1. Transfers in these set-ups all can be in the same direction on successive rows, either left or right, without creating bias in the fabric. Meshes also can be knitted in full needle rib set-up, but the transfers then must alternate left and right on alternate rows to prevent bias.

Large stockinette shapes can be suspended within a mesh. Draw a design on a graph or on a sheet for the charting attachment, then simply take mesh needles out of work, after a transfer, to create solid areas of stockinette stitches on the opposite bed. Full needle rib or 1x1 meshes knitted by the racking technique are easiest. For the same result on a smaller scale, tape over holes on a basic punchcard to produce stockinette shapes in the mesh, as in jacquard Pattern 1.

TECHNIQUES FOR MAKING CROSS BED TRANSFER LACE

1. Cast on only the bed which knits the main fabric. Set beds at half pitch, with all needles knitting stockinette on one bed; empty needles in WP on the other. On Superba and Passap, you also can knit with beds in transfer position.

2. Stitch size on the main fabric bed should be normal for stockinette; stitch size on the pattern bed should be about half that.

3. There must be an extra needle knitting at the selvedge on the main fabric so that in racking and transferring there will always be one needle knitting plain at each selvedge.

4. All manually made lace is knitted with the main fabric on the back bed and the pattern on the front bed to allow easy manipulation of needles.

5. All lace made with punchcards is knitted with the pattern needles on the main bed and the main fabric on the second bed. On Japanese machines, transfers cannot be made with the transfer carriage from the main bed to the ribber. Instead, manual transfer or the shadow lace tool must be used. On any machine, all punchcard work is done in full needle rib set-up, with the card selecting the necessary needles to knit the eyelets in each pattern row.

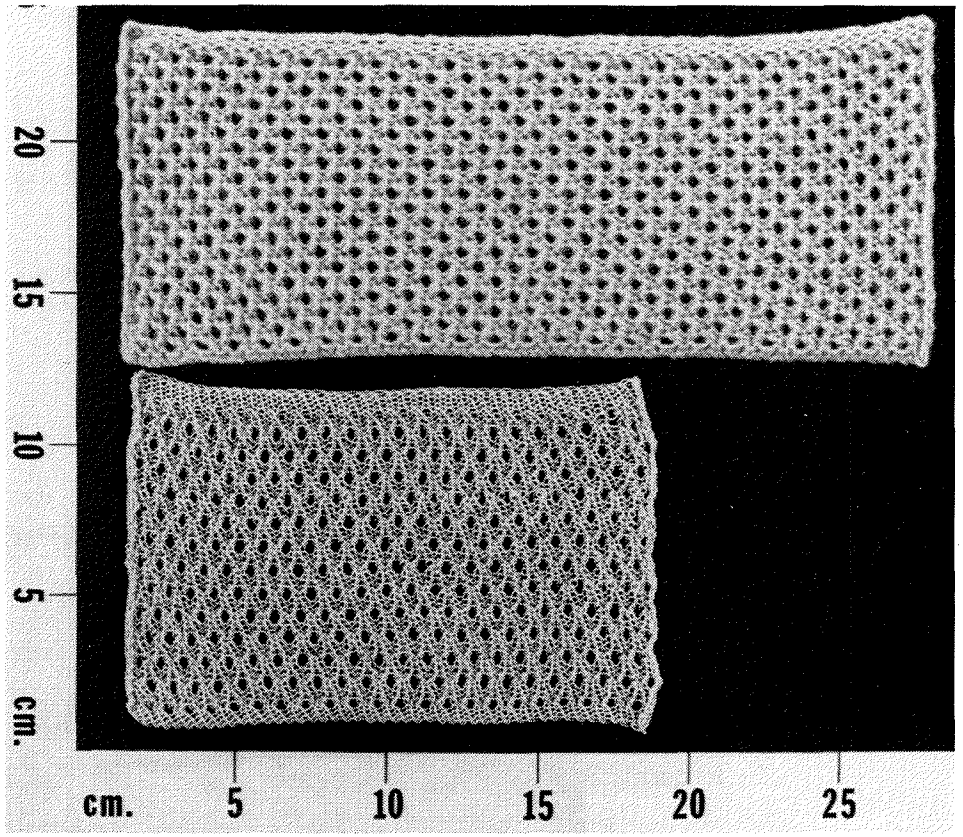
6. In both manual and punchcard work, since the fabric is knitted with beds at half pitch or in transfer position, transfers can be made to adjacent needles to the left on the opposite bed, or to adjacent needles to the right on the opposite bed. Both kinds of transferring are used in many patterns.

7. There are two basic points to remember about left and right transfers. In a manual or punchcard pattern with a *1x1 eyelet mesh*, transfers can be all in the same direction with little or no resulting bias, because the plain stitches between the eyelets will compensate and pull in the opposite direction.

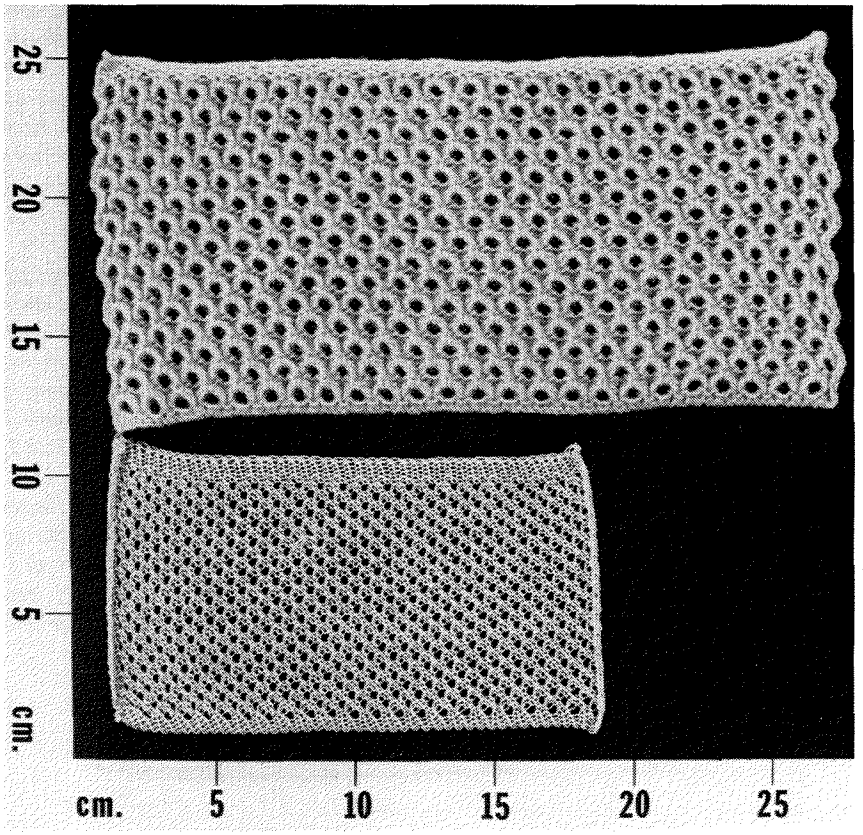
In manual or punchcard patterns with *adjacent needles* knitting eyelets, bias will occur in the direction opposite the transfer. If transfers are made in opposite directions on alternate pattern rows, the fabric will be straight, whereas if transfers are made consistently in the same direction on successive pattern rows, the fabric will bias, as shown in the checkerboard and edging swatches.

It is possible to include both left and right transfers on the same pattern row, just as in lateral transfer lace, but it is neither practical nor really necessary in this kind of lace.

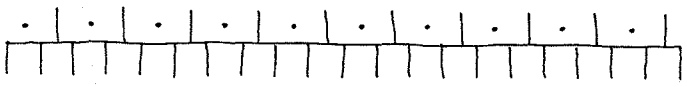
The following swatches illustrate fabrics knitted manually and those knitted with punchcards. Note in particular the possibilities for selective transfer, done either manually or with a transfer carriage. Be sure you understand how to make left and right transfers with your transfer carriage, and that you understand its method for transferring selectively.



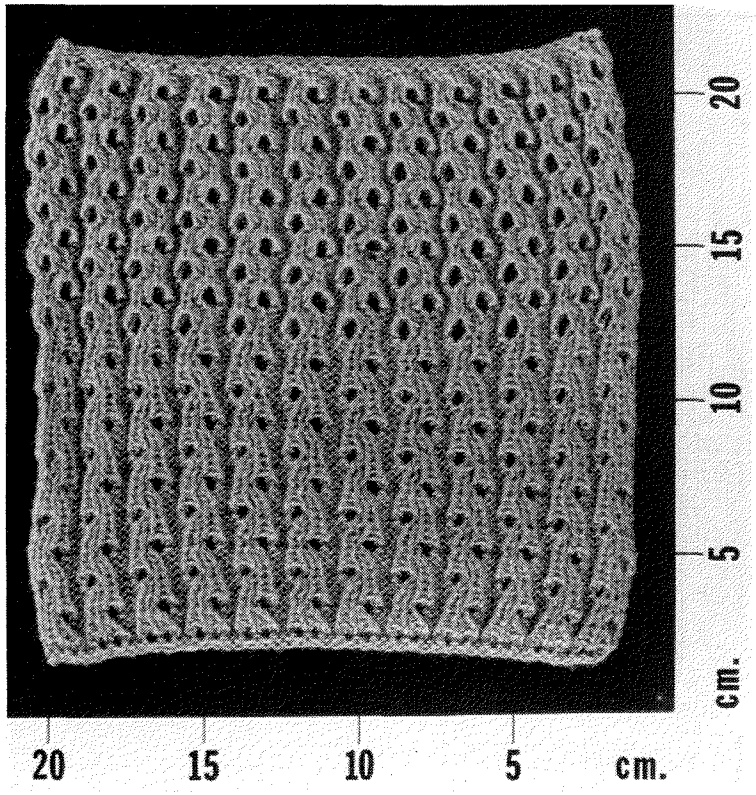
*Top. This swatch was knitted with medium weight yarn. Set both carriages for knit in both directions. *Knit 2 rows; transfer.**
*Bottom. Knitted with fine yarn. Set both carriages for knit in both directions. *Knit 4 rows; transfer.**



*Top. Knitted with medium weight yarn. Set back bed carriage for knit throughout. *Set front bed carr for knit; knit 1 row. Set front bed carr for tuck; knit 2 rows. Set front bed carr for knit; knit 1 row; transfer.**
*Bottom. Knitted with fine yarn. Set back bed carriage for knit throughout. *Set front bed carr for knit; knit 1 row. Set front bed carr for slip; knit 1 row; transfer.**



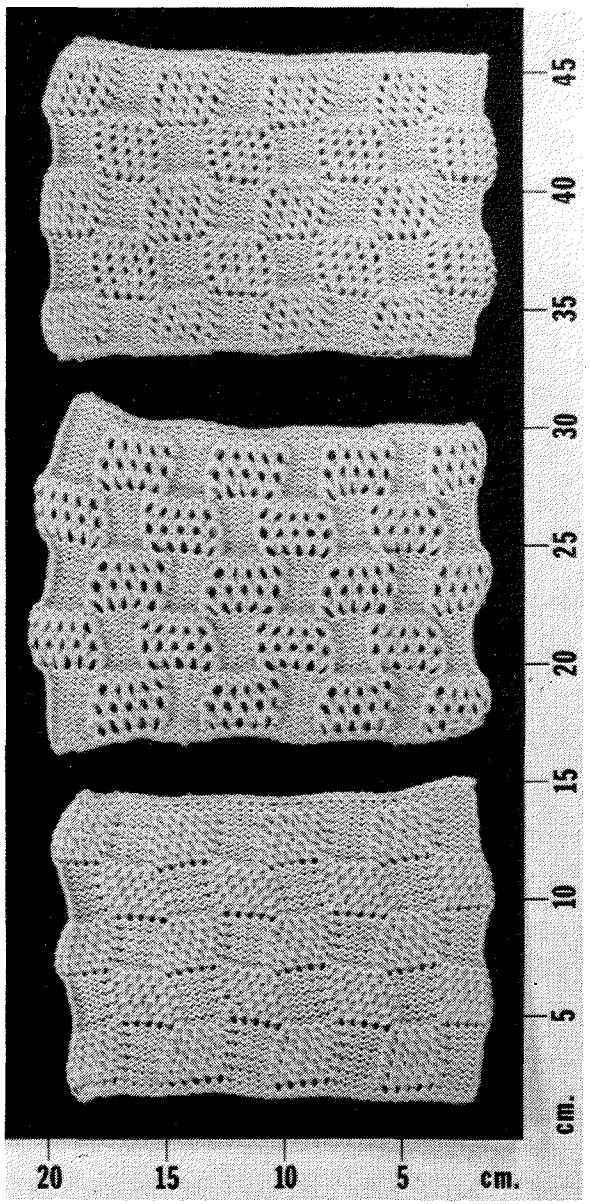
1x1 meshes, for all machines. All transfers are in the same direction on successive rows, either left or right. After each transfer, rack one needle and repeat the sequence.

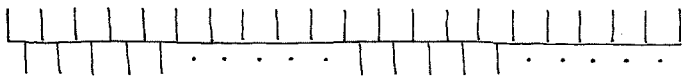


Manual patterns, for all machines. 2x2 embossed rib. Transfers done manually or with transfer carriage.
*Bottom. Set both carriages for knit throughout. *Knit 4 rows; transfer st 1 to ndl 3. Knit 4 rows; transfer st 2 to ndl 3.**
*Top. Set back bed carr for knit throughout. *Knit 4 rows so ndls numbered 1 tuck and ndls numbered 2 knit; transfer st 2 to ndl 3. Knit 4 rows so ndls numbered 2 tuck, and ndls numbered 1 knit; transfer st 1 to ndl 3.**

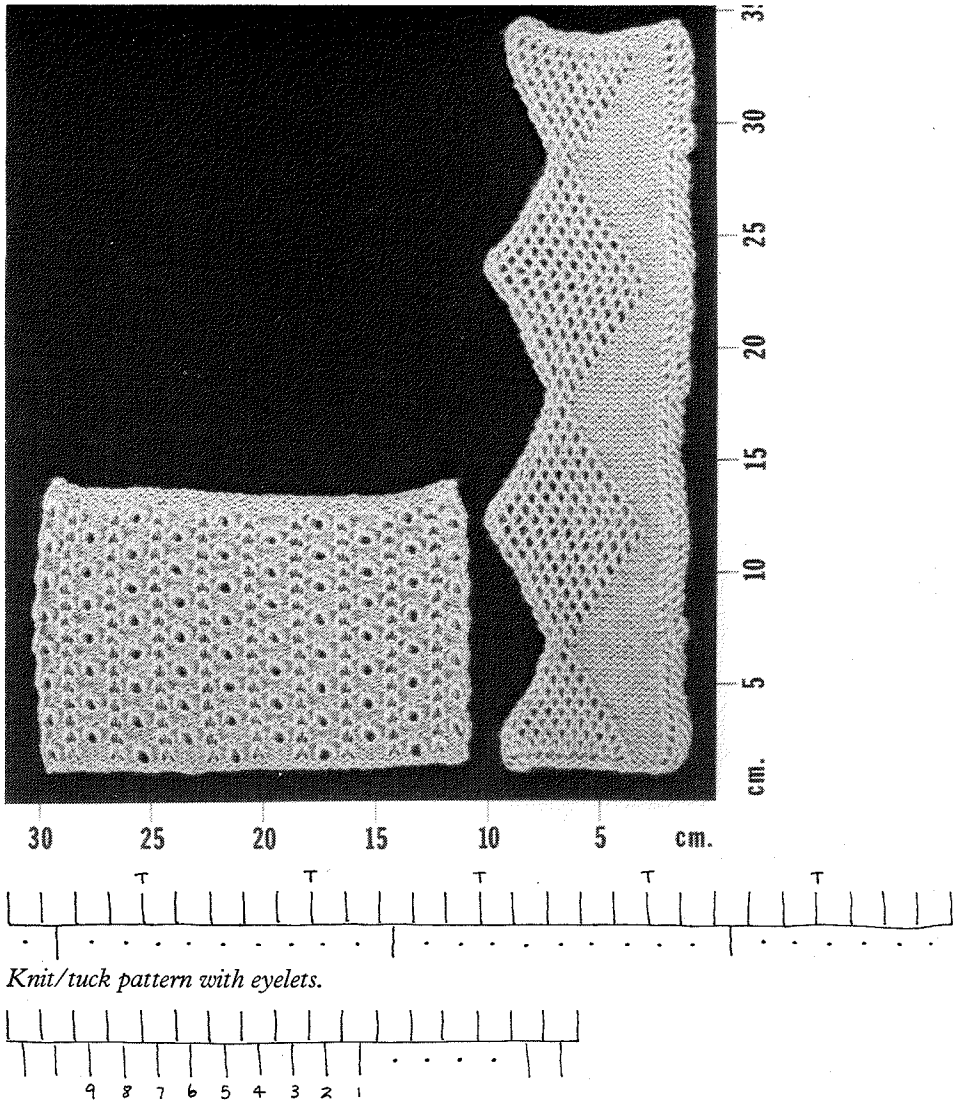
2x2 embossed rib.

Manual patterns. Bias checks. Swatches illustrated were knitted with medium weight yarn. Rack bed to one end before set-up. For all machines.
Knit 3 to 5 sequences, transferring L after each sequence, rack 5 spaces. Repeat, transferring R after each sequence, rack 5 spaces.
*Top. Set both carriages for knit in both directions. *Knit 2 rows; transfer.* Five sequences per check.*
*Center. Set back bed carriage for knit throughout. *Set front bed carr for knit; knit 1 row. Set front bed carr for tuck, knit 2 rows. Set front bed carr for knit; knit 1 row; transfer.* Three sequences per check.*
*Bottom. Set back bed carriage for knit throughout. *Set front bed carr for knit; knit 1 row. Set front bed carr for slip; knit 1 row; transfer.* Five sequences per check.*





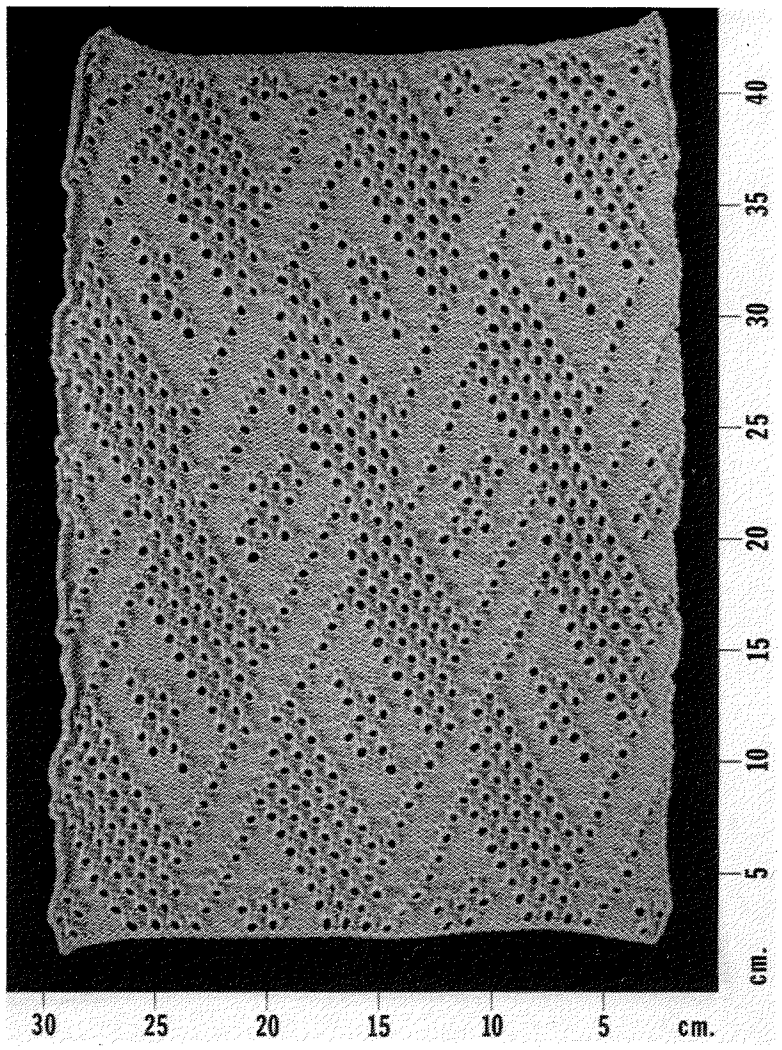
Bias check.



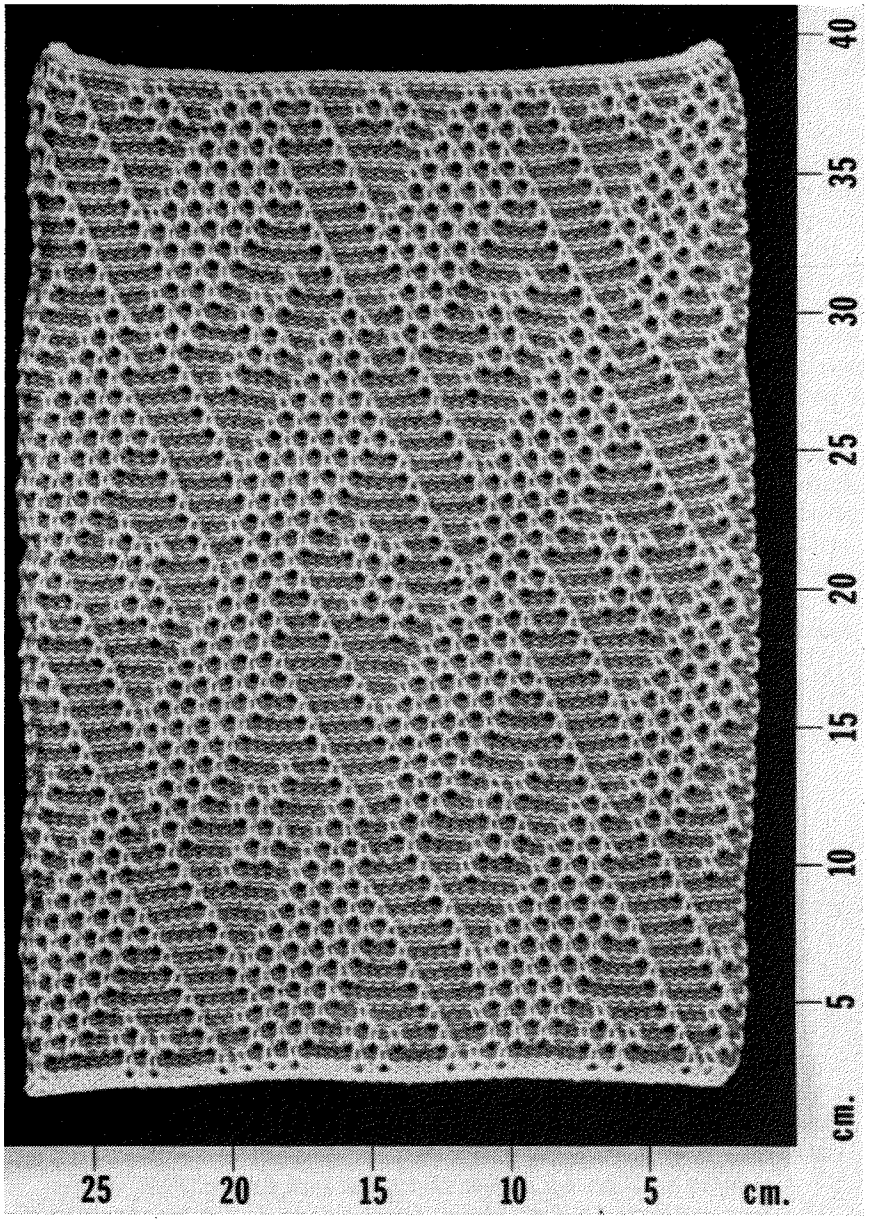
Knit/tuck pattern with eyelets.

Bias edging.

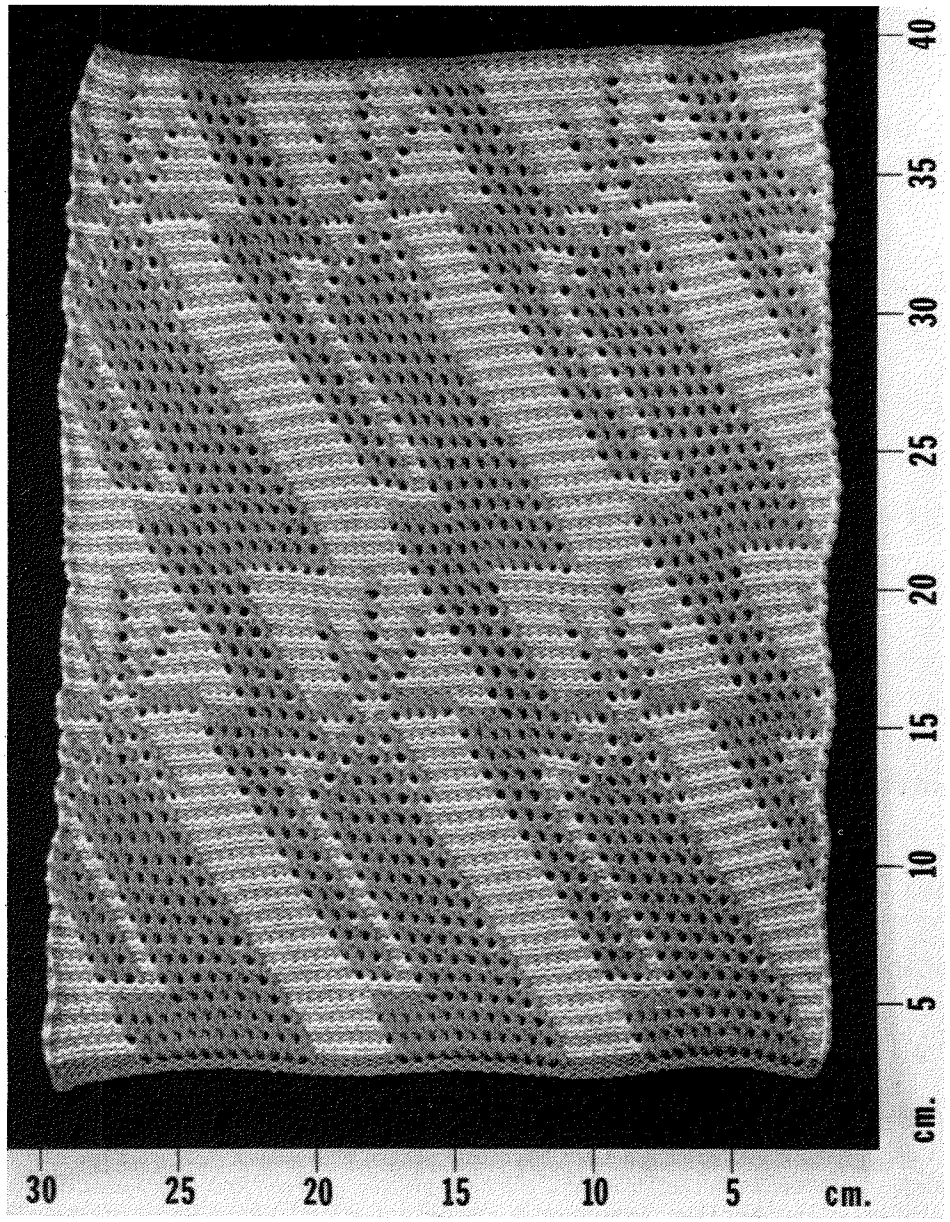
*Manual patterns, all machines. Left. Knit/tuck pattern with eyelets. *Set front bed carr for tuck, set back bed carr so ndls marked T will tuck, those between will knit; knit 3 rows. Set both carriages for knit; knit 1 row. Transfer single front bed sts L or R to back bed. Rack 5 ndls.* Repeat. Right. Bias edging. Set cams on both beds to knit. Set up as shown in diagram, then cast on back bed. *Step 1: knit 2 rows; transfer all sts left. Step 2: put ndl 1 to NWP. Step 3: repeat step 1. Step 4: repeat step 2, putting ndl 2 to NWP. Continue steps 1 and 2 until 9 ndls are in NWP (RC20). Step 5: knit 2 rows, transfer all sts right. Step 6: put ndl 9 in WP. Continue steps 5 and 6 until 9 ndls are in WP.* Repeat entire sequence of steps 1 through 6 (RC40).*



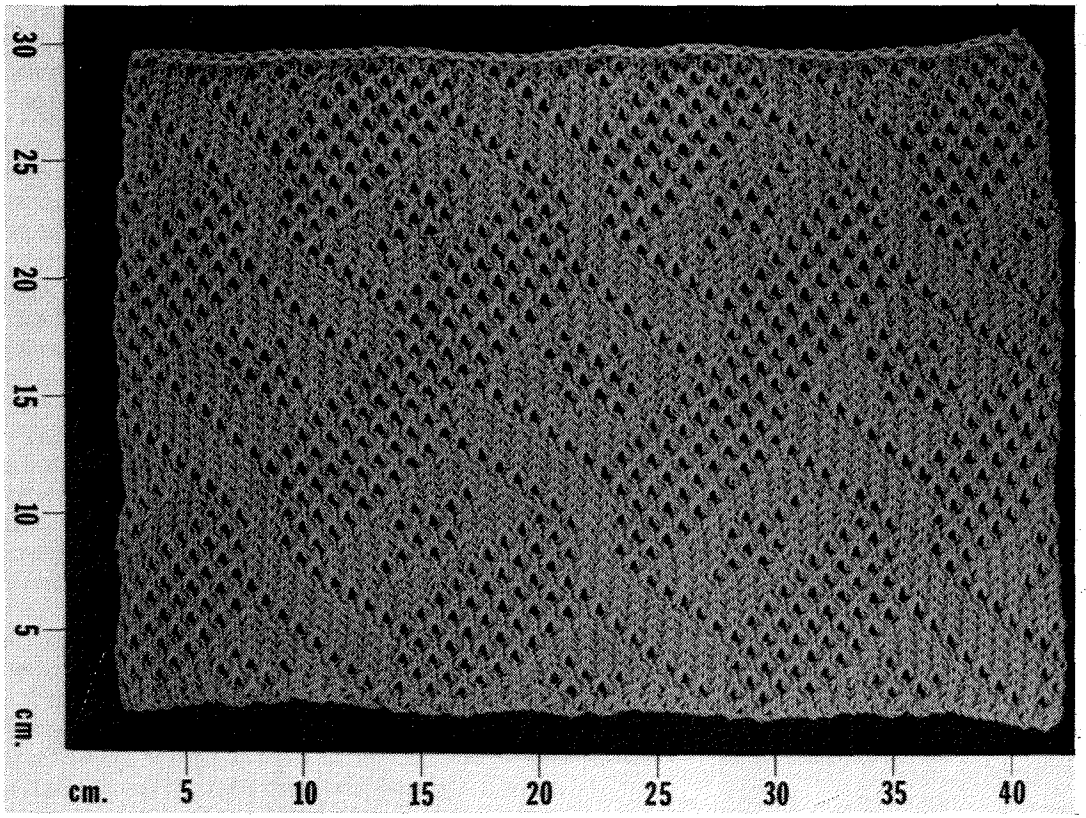
Jacquard punchcard patterns with all pattern stitches across each pattern row transferring at once. These fabrics are best knitted on Passap and Superba, since stitches must be transferred from MB to second bed. On Passap, set the Deco to 4, on Superba, rotate the card manually every fourth row. All transfers are either left or right throughout each pattern. FNR set-up.
*Jacquard Pattern 2. One color, 1x1 mesh pattern. In a jacquard pattern, the tuck stitch mesh can be knitted only on Superba. Set the second bed carr to knit; MB carr for slip. On MB carr, *put ndl return buttons in upper pos for 3 rows, in lower position for 1 row, then transfer.* On Passap, make the mesh as in the next swatch; but in 1 color: Deco 2, back carriage N, front carriage BX, *knit 2 rows, transfer.**



*Jacquard Pattern 2, best for Passap and Superba. Two-color, 1x1 mesh pattern. Set MB carr for slip; second bed carr for knit. *Knit 2 rows with col 1 (light) in patt; knit 2 rows col 2 (dark) on backing alone, then transfer.**



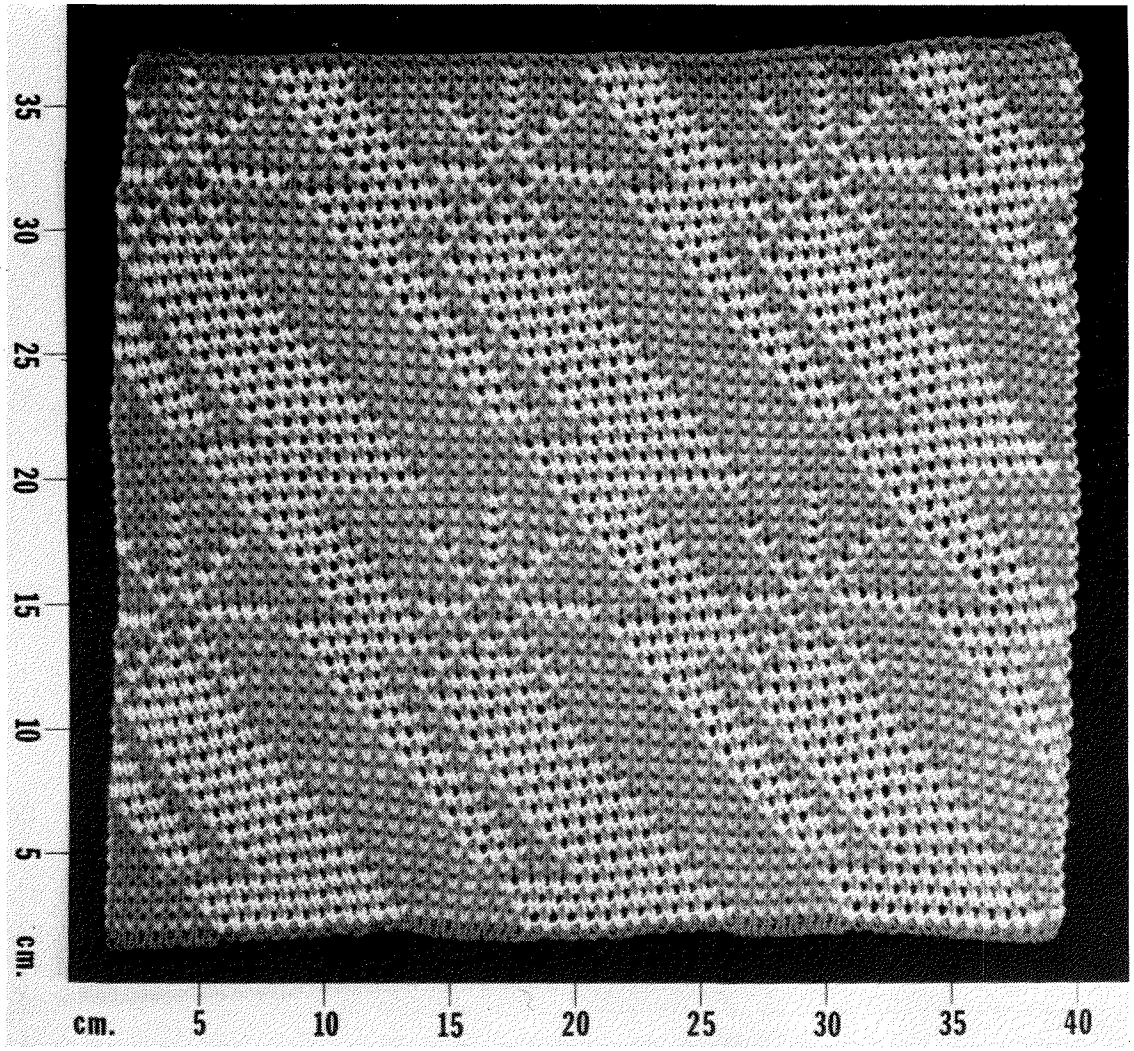
*Jacquard Pattern 6, best for Passap and Superba. Two-color, adjacent needle mesh. Set MB carr for slip, second bed carr for knit. *With col 1 (dark), knit 2 rows in pattern. With col 2 (light) knit 2 rows on backing alone, then transfer.*All transfers are L on Passap, R on Superba. No bias will occur because pattern is diagonal.*



Jacquard punchcard patterns with selected pattern stitches transferring. Only for Passap with U-80. With this technique, almost any double bed fabric can be knitted with eyelets. All needles on both beds will knit, but only those needles with pushers in WP will transfer their stitches to make eyelets. FNR set-up, U-80 1 or 5.

*Jacquard Pattern 2, one color. Set Deco 4. Set back bed carr N throughout. *Set front bed carr N; knit 1 row. Set front bed carr AX, no arrow key; knit 3 rows. Transfer L.**

*Jacquard Pattern 2, two colors. Set Deco 4. Set back bed carr N, front bed carr BX, left arrow key. *Knit 2 rows col 1 (dark); knit 2 rows col 2 (light). Transfer L.**



*Jacquard Pattern 6, two colors, for Passap. Set Deco 4. Set back bed carr on N throughout; left arrow key on the front bed carr throughout. *With col 1 (dark): set front bed carr N, knit 1 row. Set front bed carr AX, knit 1 row. With col 2 (light): set front bed carr to AX; knit 2 rows. Transfer L.**

LACE MADE BY DROPPING STITCHES

Drop stitch lace is also known as *drive* or *release stitch lace*, and is made by a double bed technique similar to cross bed transfer. The main fabric, usually stockinette, is knitted on one bed; selected needles knit pattern stitches on the other for one or more rows. Pattern stitches are then dropped from the needles. They unravel back to their starting point, creating extra-large open stitches in the adjacent stitches on the opposite bed. In cross bed transfer, pattern stitches are transferred to the main fabric instead of being dropped.

This technique is usually thought of as a punchcard technique, but lends itself equally well to manual patterning. In manual work, the main fabric is made on the back bed and the patterning done on the front so patterning needles are more accessible. Stitches are released by uncoupling the carriages and moving the front carriage across by itself. On Singer/Studio the P carriage may be used. A pattern ruler also may be used, particularly if not all the stitches are to be dropped.

If the pattern is to be made automatically with a punchcard, then, on all machines except Passap, the main fabric is knitted on the front bed and the pattern on the back bed. Stitches must then be released with a pattern ruler, or with the P carriage on Singer/Studio.

TECHNIQUES FOR MAKING DROP STITCH LACE

1. Cast on only the bed which knits the main fabric. If the lace pattern is to be begun after ribbing or some other double bed fabric is knitted, all stitches must be transferred to the main fabric bed. Otherwise, the dropped stitches will unravel all the way down the ribbing too!

2. Set beds at half pitch, with an extra needle at both selvedges of the main fabric.

3. On all machines, use enough weights to pull the released stitches down between the beds so they won't catch in the needles when the next row is knitted.

4. Stitch size on the main fabric bed should be the normal one for stockinette. On the patterning bed, the stitch size should be one, two, or more sizes smaller, depending upon the size you would like the open stitches.

5. Fuzzy yarn, attractive in dropped-stitch lace, may not always release or unravel cleanly. Be patient!

6. Depending upon the pattern, it will be necessary to release the stitches from the pattern needles after every pattern row (in one-color jacquard patterns), after groups of pattern rows (in bubble or check patterns), or after the knitting is completed (in mesh and two-color jacquard patterns).

7. If, when knitting a garment, the stitches are to be dropped after knitting, be sure to drop the stitches also during bind-off for armholes and necklines.

DIFFERENT METHODS OF KNITTING DROP STITCH LACE

There are two basic types of drop stitch fabric, stockinette mesh and half Milano mesh. Both can be used with either manual or punchcard patterning, and each produces a different effect. The zigzag racking patterns shown in the photo illustrate the difference.

The stockinette mesh swatch was knitted with an equal number of rows on both beds, with the pattern bed stitches released. The resulting mesh is in enlarged stockinette stitches, hence its name.

The swatch showing half Milano mesh has a horizontal ridge between every two rows of mesh on the purl side, which occurs when two rows are knitted on the main fabric bed and only one row on the pattern bed. This ridge makes the fabric more stable. When this mesh is knitted with the smallest possible stitch size on both beds, the mesh practically disappears and the fabric is a solid one in mock garter stitch. Simple patterning can be incorporated in this mesh, as shown in the first group of swatches illustrated.

The second group of swatches shows check patterns. These are made with a 5x5 needle set-up on the front bed, which is racked to the alternate position after each sequence. The mesh is the stockinette type, which will "bubble" when released. Many of these patterns are exceptionally pretty when knitted in two-color stripes. The last swatch in this group shows a way to make the bubble truly three-dimensional.

For a check pattern knitted in the insertion technique, select alternating groups of needles to knit *one row* at an enlarged stitch size, then drop the stitches; knit another row with the alternate groups of needles, drop those stitches, and repeat. To emphasize the pattern, insert a few rows of mock or true garter stitch between the rows of enlarged stitches. Examples are shown in the photographs.

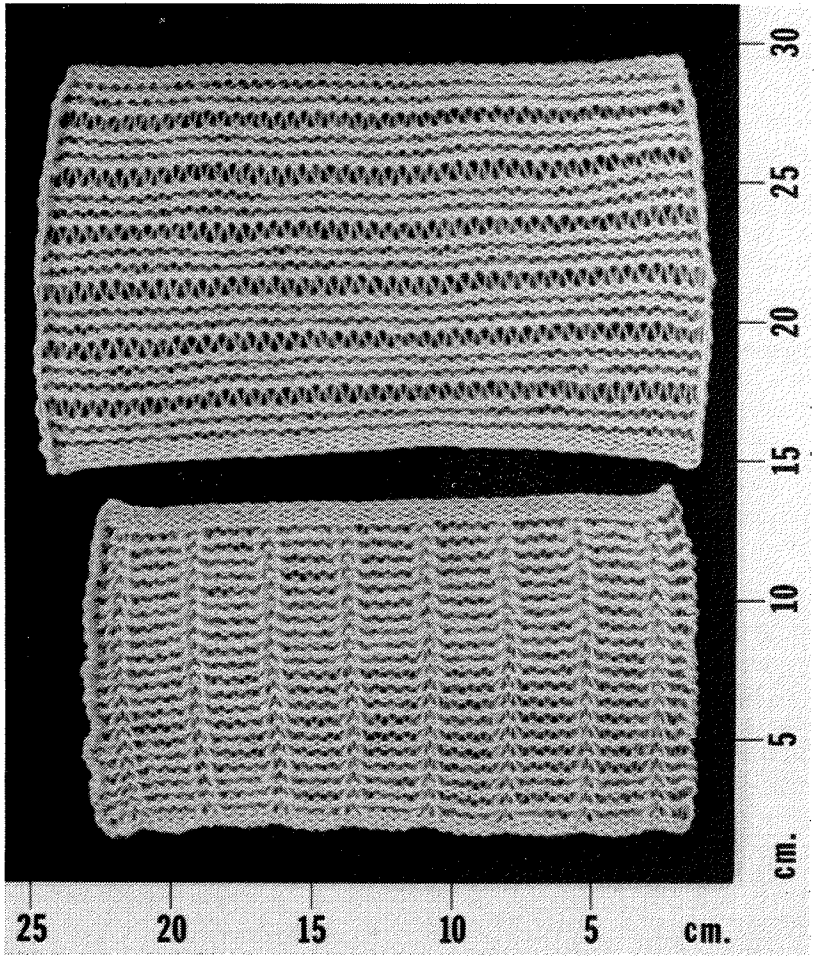
A decorative insertion can be added to a plain or patterned fabric by crossing or twisting very large dropped stitches. One row of stitches on each bed is knitted at the largest stitch size possible for the yarn, and the front bed loops released. Then the elongated stitches on the back bed can easily be manipulated and arranged.

The swatch illustrating four simple patterns should give you some further ideas for patterning drop stitch fabrics without a punchcard.

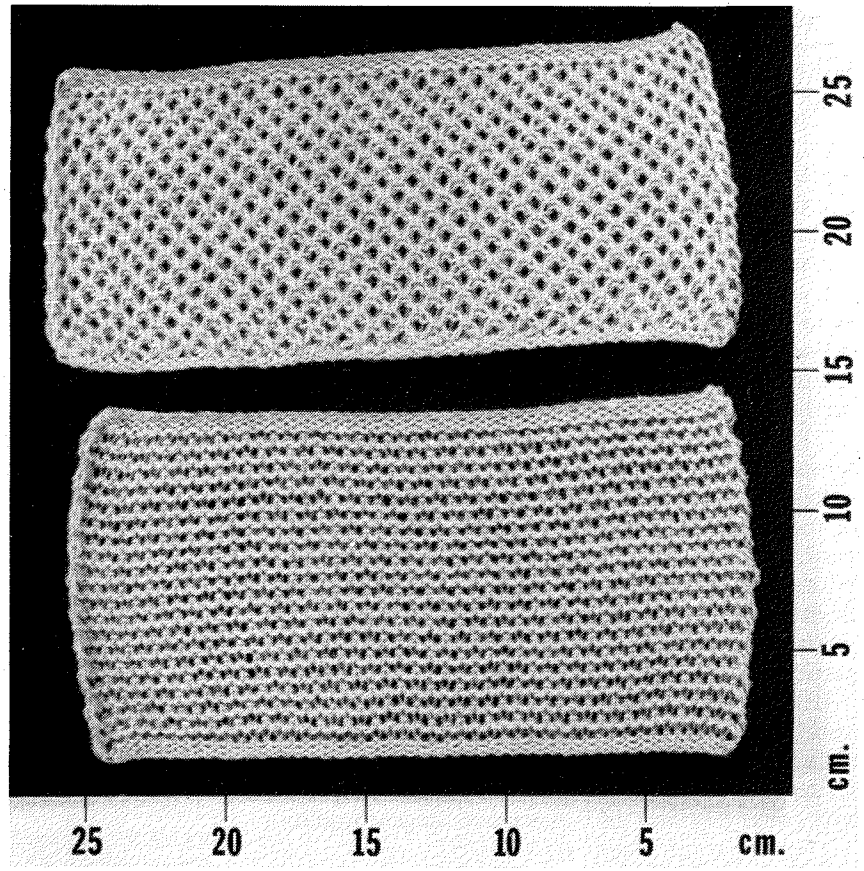
JACQUARD PUNCHCARDS

Directions in both the Singer/Studio and Passap instruction books indicate that jacquard patterns in dropped-stitch lace should be knitted with the half Milano mesh. The punchcards that come with the Singer/Studio ribber have pattern holes punched every other row, and they can be used on the Brother/Knitking as well. These particular punchcards limit the pattern to half Milano mesh. However, almost any type of punchcard can be used, not just the every-other-row kind. Jersey jacquard punchcards (Type A) work especially well for one-color patterns. Set the card rotation for every other row, and set the main carriage so it will knit/slip the first row of each sequence in pattern, and slip completely the second row, while the ribber knits all rows. In one-color knitting such as this, the stitches must be dropped after each pattern row.

In two-color jacquard knitting, Type C punchcards are the best choice for Superba and the Japanese machines. The stitches can be dropped after the knitting is completed and before the bind-off, then unravelled after the knitting is removed from the machine. Illustrated in the swatches are three ways to

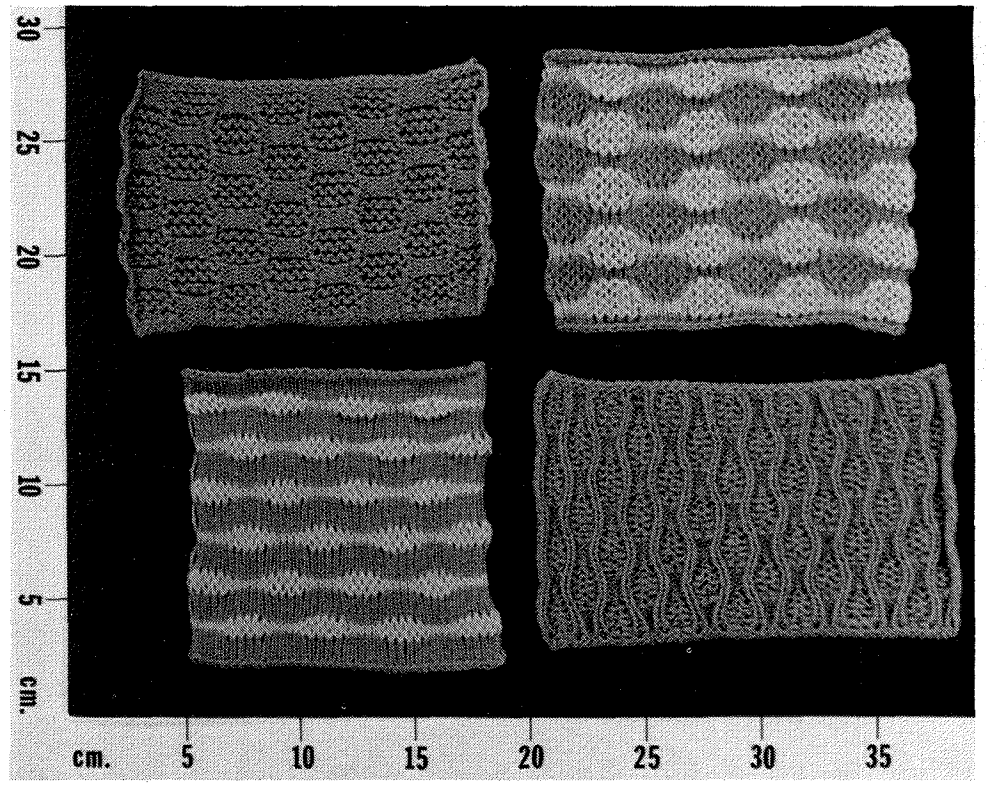


A variety of meshes, all based on half Milano fabric. FNR set-up. Cast on back bed. Release front bed stitches after knitting is finished.
*Top. Basic half Milano mesh. Set BB for knit. *Set FB for knit; knit 1 row. Set FB for slip; knit 1 row.* Pattern is varied by the stitch size, in this case: RC4, SS 5/2; RC2, SS 5/7.*
*Bottom. 5x1 tuck variation. On BB, use pushers, punchcard, or pattern ruler to make every 6th ndl tuck; remainder knit. *Set BB for tuck, FB for knit. Knit 1 row. Set BB for knit, FB for slip; knit 1 row.**

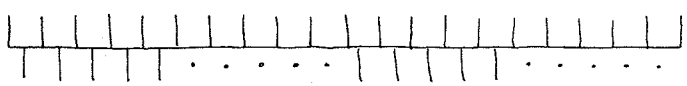


*Top. 1x1 tuck variation. Back bed: with cams set for tuck, knit odd ndls and tuck even ndls for 2 rows, alternate the selection for next 2 rows. *Set FB for knit; knit 1 row. Set FB for slip; knit 1 row.* Alternate BB selection next sequence.*
*Bottom. 1x1 tuck variation. Back bed selection as above. *Set both beds for knit; knit 1 row. Set BB for tuck, FB for slip; knit 1 row.* Alternate BB selection next sequence.*

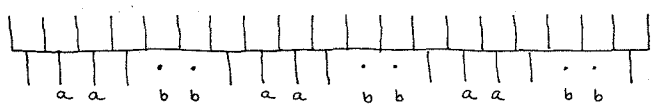
knit two-color jacquard drop stitch, and many more can be invented. The three ways illustrated are simply straightforward rib jacquard knitting in striper backing, half Milano, and tucked bird's-eye, with the main bed stitches dropped and unravelled. How about trying this in three or four colors per row? Generally the stitch size should be reduced on both beds by about one or two numbers from that normally used for these rib jacquard fabrics. The cam settings can be found in the Jacquard chapter with the discussion of the fabrics named.



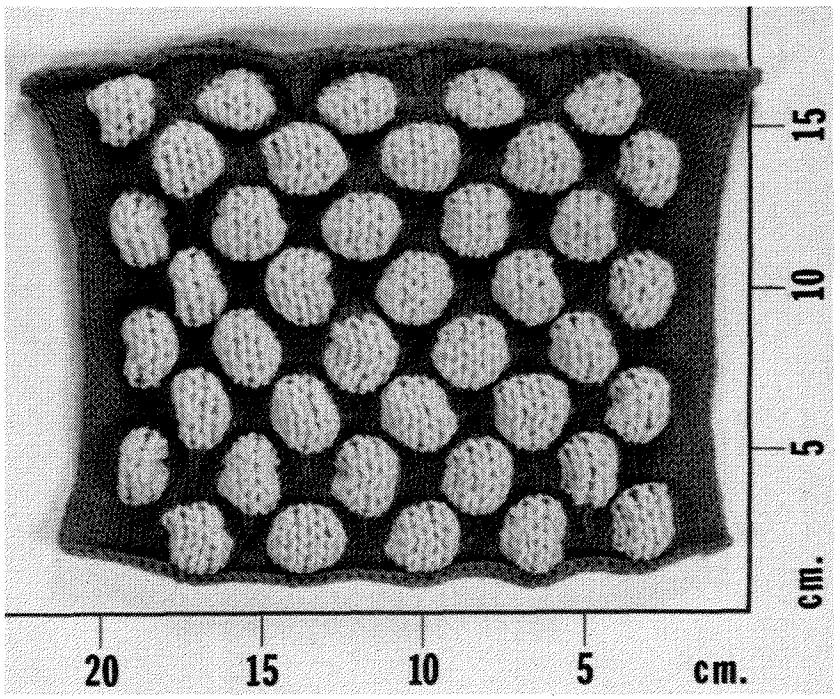
Check patterns. All knitted in stockinette mesh with front bed stitches released after each sequence, before racking. Cast on back bed.
*Top left. Purl side shown. *Set both beds for knit; knit 4 rows, release FB sts, rack 5 ndls.**
Top right. Knit side shown. Knit as top left, but change color every 4 rows.
Bottom left. Knit side shown. Knit 6 rows with col 1 (dark) on BB alone; knit 2 rows with col 2 on both beds. Release and rack as in top left.
Bottom right. 2x4 check with rib. In this pattern the beds cannot be racked, since rib stitches are not released. Cast on BB. Hang purl loops on FB ndls, which are neither a *nor* b. *Set both beds for knit. *Knit 6 rows; release* aa *sts and put* aa *ndls in NWP. Move* bb *ndls to WP, knit 6 rows; release* bb *sts and put* bb *ndls in NWP. Move* aa *ndls to WP.**



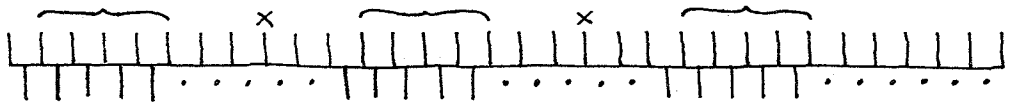
Set-up for swatches at top left, top right, and bottom left in the photo above.



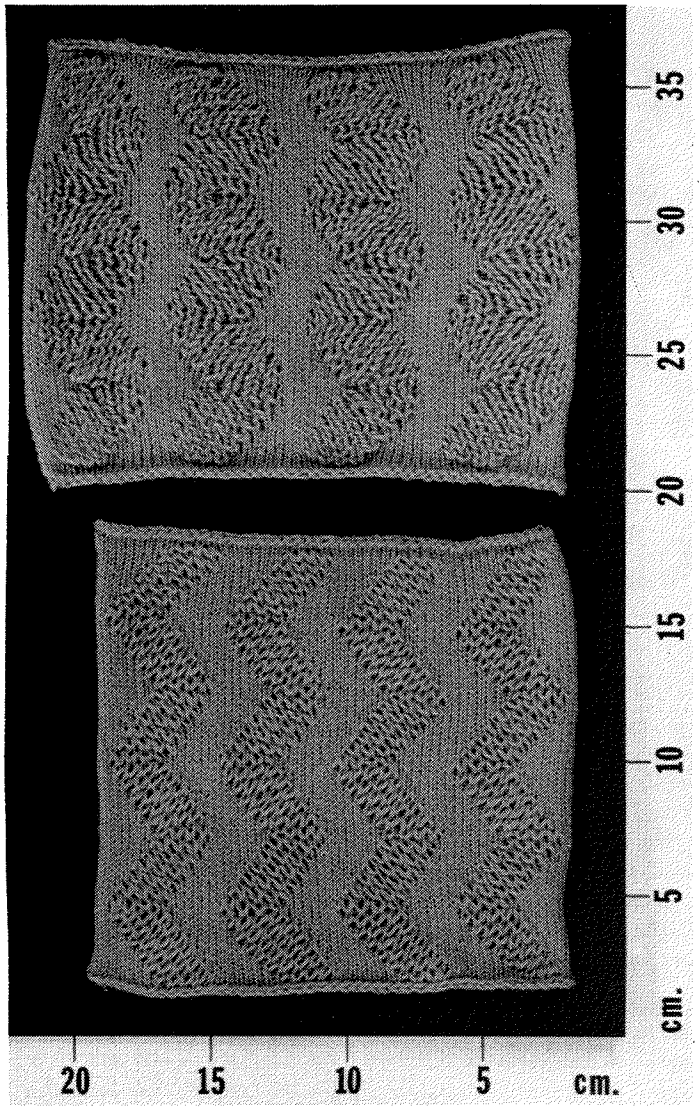
Set-up for swatch at bottom right in the photo above.



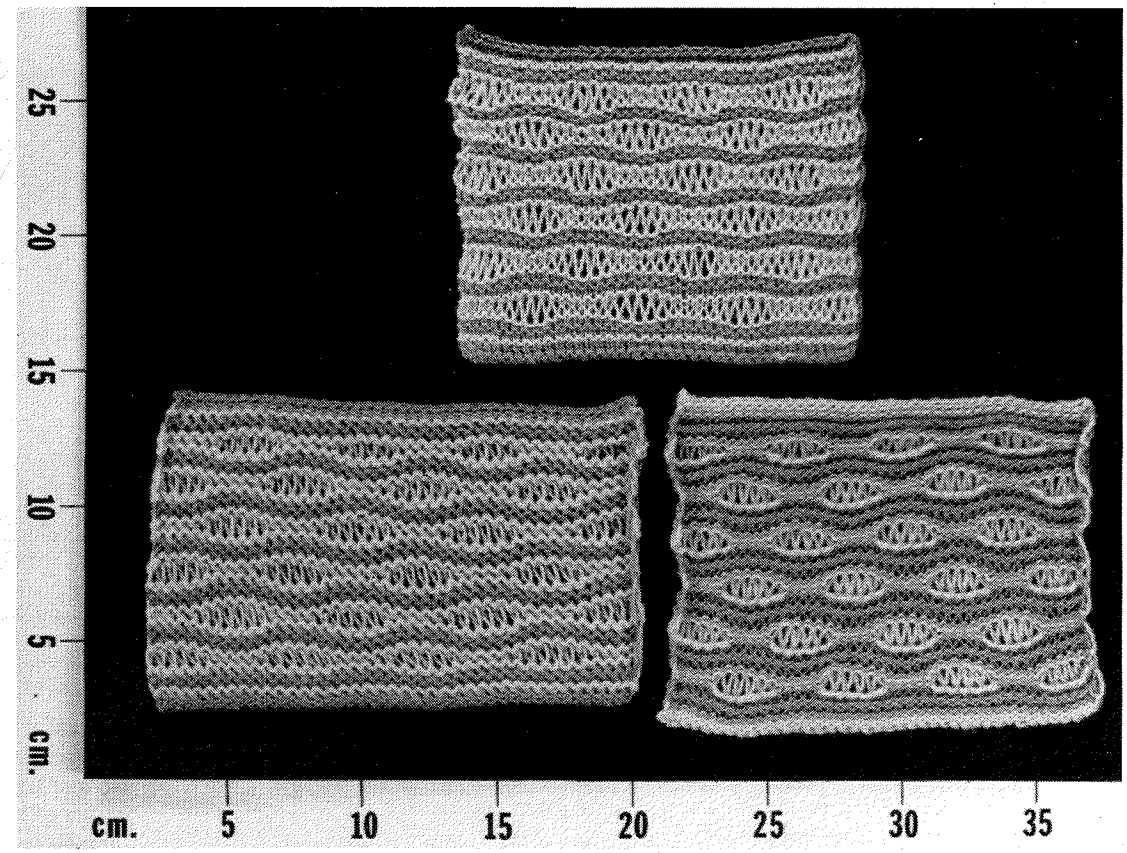
*Three-dimensional bubble pattern. 5x5 selection on the back bed can be made with punchcard, pushers, or pattern ruler. Rack beds to one end before setting up. Cast on BB and knit 6 rows with col 1 (dark). *Set BB carr for slip and FB for knit. Select groups of 5 ndls on BB across from those on FB so these groups will knit in FNR (brackets), with floats between groups. Knit 6 rows with this selection in col 2 (light). With work hook, reach down between beds and pull up each group of 6 floats and hang them together on the* x *ndl on BB. With col 1, knit 6 rows of stockinette on BB, dropping FB sts after 2 rows have been knitted. When the 6 rows are completed, rack beds 5 spaces for the next bubble.**



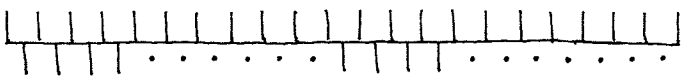
Set-up for three-dimensional bubble pattern.



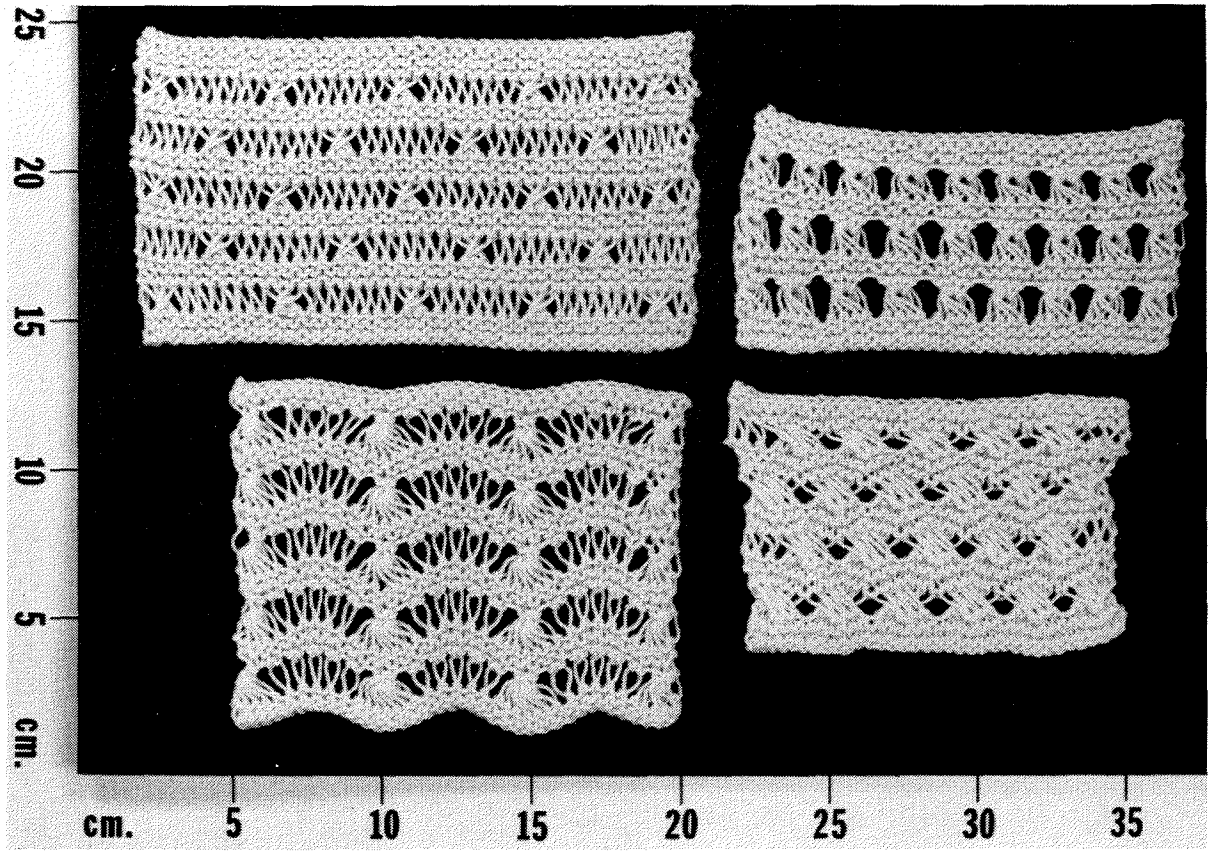
*Racked pattern illustrating both meshes. Knit side shown. Cast on BB. *Knit 2 rows, rack 1 ndl* 6 times, then reverse racking direction. Sts are released after knitting.*
Top. Stockinette mesh. Set both carriages for knit.
*Bottom. Half Milano mesh. Set BB carr to knit. *Set FB carr to knit; knit 1 row. Set FB carr to slip; knit 1 row.**



Insertion type check patterns, combined with mock and true garter stitch. FNR set-up. Cast on back bed. Set BB carr for knit throughout. 5x5 selection for check is made on front bed with pattern ruler or pushers, without racking. Only 1 row with selection is needed to make the check: with FB carr set for slip, knit across all BB sts, plus selected groups of 5 sts on FB, then drop FB sts. Enlarge SS on FB for the one row of the check pattern, then reduce SS for the garter rows. Additional instructions for mock and true garter stitch are given in Chapter 12, Embossing.
*Top. Check and garter stitch. *Knit 2 rows garter st with col 1, transfer. Knit 2 rows garter st with col 2. Knit 1 row garter st with col 1. Knit 1 row check with col 1; finish transfer for garter stitch.**
*Bottom left. Check and cross bed transfer mock garter stitch. *Knit 2 rows mock garter with col 1. Knit 2 rows mock garter with col 2. Knit 1 row mock garter with col 1. Transfer sts, knit 1 row check, release.**
*Bottom right. Check and drop stitch mock garter. *Knit 8 rows mock garter with col 1 (RC 2 knit, RC2 release); knit 4 rows check with col 2 (RC2 knit, RC2 release).**



Set-up for racked patterns.



Decorative insertions. FNR set-up. Cast on back bed, or transfer all FB sts to BB. Knit 1 row across all ndls on both beds with largest possible SS, then drop FB sts. The enlarged sts on the BB can then be twisted, crossed, spread out, or doubled. To complete the sequence, knit one row at stockinette SS across BB sts only. Then a few rows can be knitted in garter st, as shown, or in stockinette or pattern before the next insertion.

Top left. First repeat: cross sts 1 and 2. Second repeat: cross sts 3 and 4.

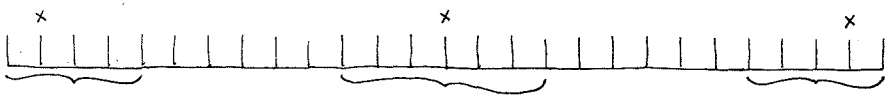
Top right. Gather 4 sts together and hang across ndls x *and* y. *Empty ndls between will take new loops on next row.*

Bottom left. Gather the 7 sts in brackets (5 on ends) and hang on ndl x. *Spread out remaining 5 sts so alternate ndls will be empty.*

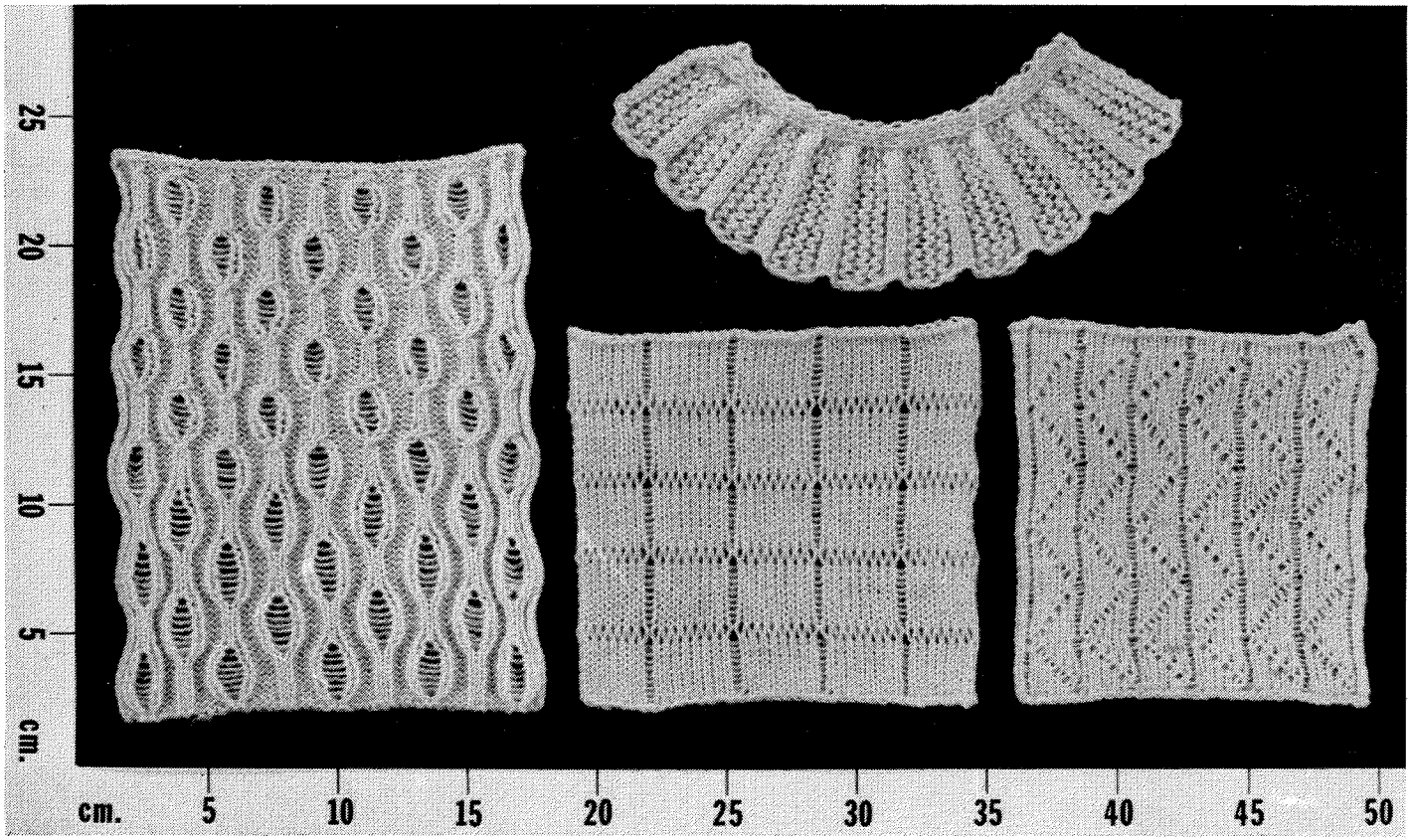
Bottom right. With a pair of 3-decker tools, cross 3 sts with 3 adjacent sts, as for cables. Stagger or alternate crossings at each repeat.

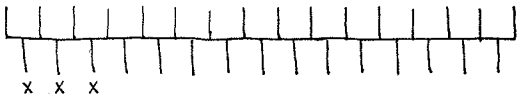
Set-up for swatch at top left in the photo.

Set-up for swatch at top right in the photo.



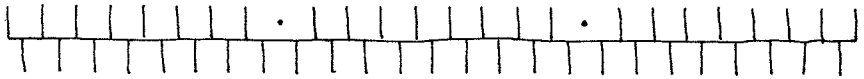
Set-up for swatch at bottom left in the photo.



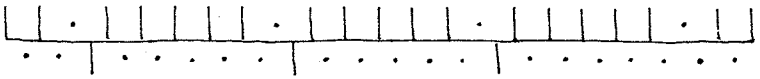


Passap ruffle, swatch at top in the photo above.

Drop stitch rib, swatch at bottom left in the photo.



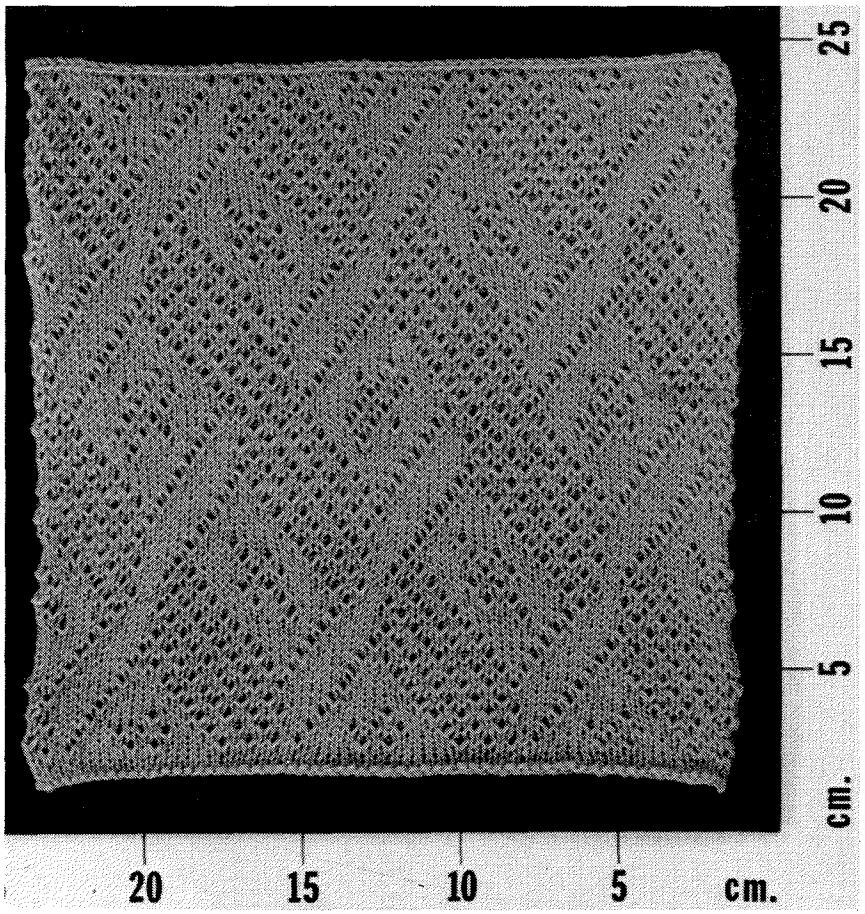
Windowpane pattern, swatch at bottom center in the photo.



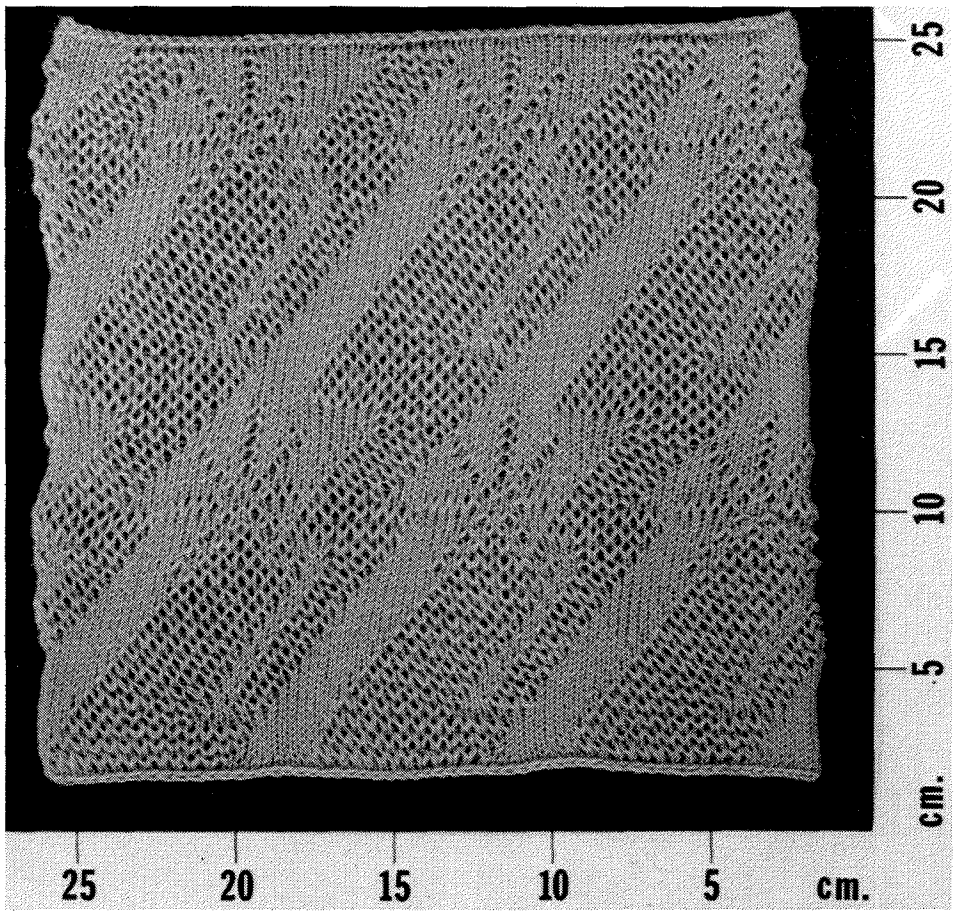
Zigzag pattern, swatch at bottom right in the photo.

Four simple patterns.

*Top. Passap ruffle (can be made on all machines). Cast on back bed. *Knit 4 rows on back bed only. Knit 4 rows on both beds.* When knitting is completed, release FB sts except those marked* x.
*Bottom left. Drop stitch rib, plain or crossed. Set both carrs for knit. *Put* a *ndls in WP; knit 8 rows on both beds. Drop sts on* a *ndls and put* a *ndls in NWP. Put* b *ndls in WP; knit 8 rows on both beds. Drop sts on* b *ndls and put* b *ndls in NWP.* For crossed rib, cross sts* 1 *and* 2 *every 8 rows.*
*Bottom center. Windowpane pattern. Cast on BB. *Knit 9 rows on BB only. Knit 1 row on both beds; release FB sts.**
*Bottom right. Zigzag. Cast on BB. Set BB carr for knit. Set FB carr for knit 1 row, slip 1 row. *Knit 2 rows, rack 1 ndl* 5 times, moving across the group of S sts, then release FB sts. Continue, racking in the opposite direction.*

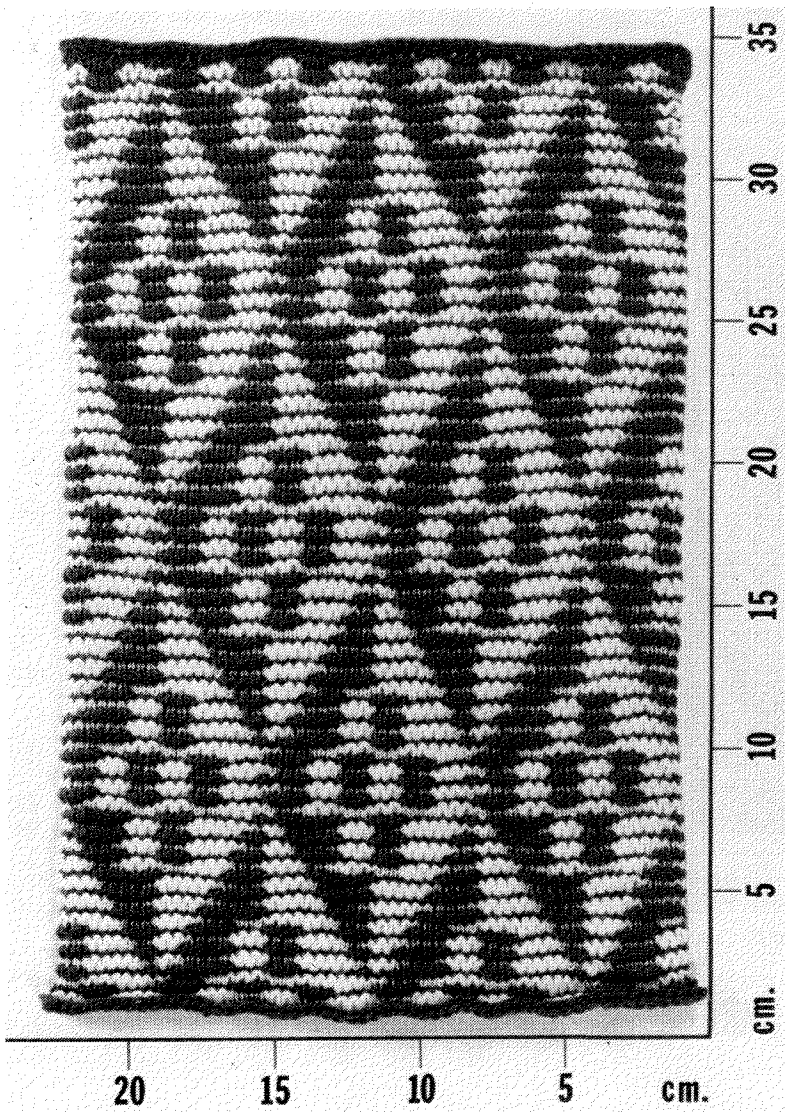


Jacquard Pattern 2.



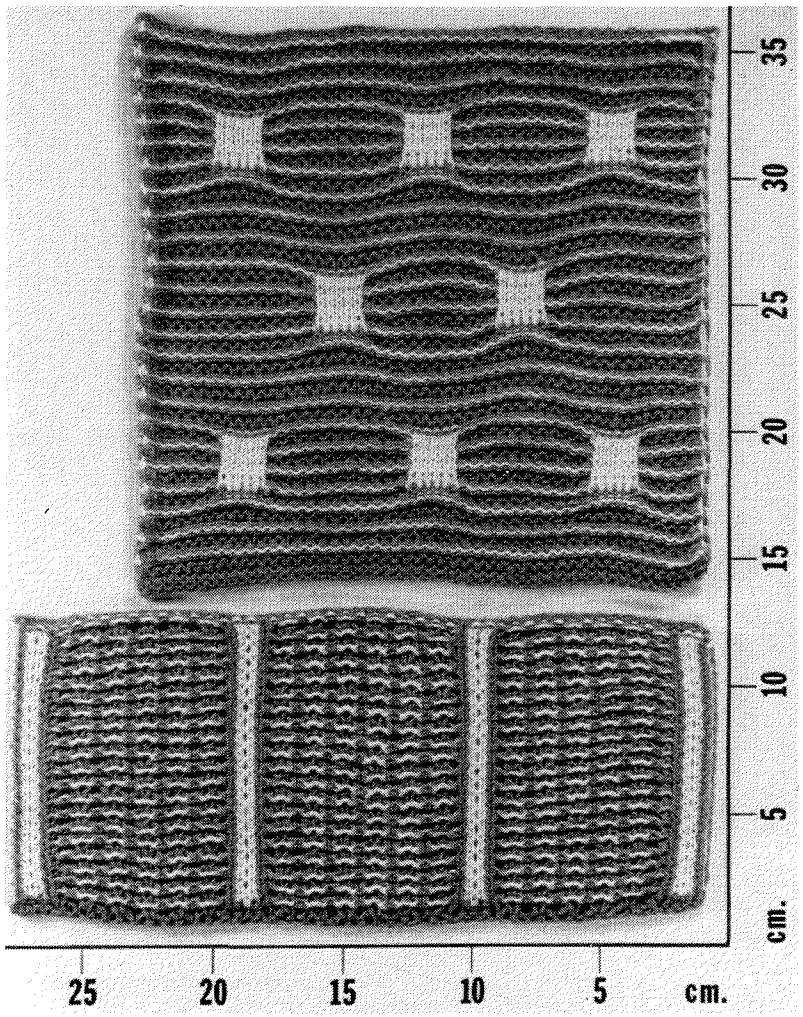
Jacquard Pattern 6.

One-color jacquard patterns made with half Milano mesh. On all machines except Passap, the fabric must be turned so needles may be selected on the back bed for the pattern. FNR set-up. Cast on front bed. Set the FB carr for knit, the BB carr to knit 1 row, knit/slip in pattern 1 row. The punchcard must rotate EOR. Drop stitches on BB every two rows with a pattern ruler.



Half Milano backing with stitches on the MB dropped and unravelled after knitting. The right side is made on the second bed. Jacquard Pattern 5.

Two-color jacquard patterns made by knitting a rib jacquard fabric, then dropping and unravelling MB stitches afer knitting. The three fabrics and three methods illustrated are interchangeable. See the chapter on Jacquard fabrics for details of knitting these backings.



Top. Striper backing. The pattern is a white check on a solid dark background, with three pattern rows of background between the four check rows. The first three pattern rows knitted with col 1 (dark), selecting all ndls on the MB. Col 2 knits backing only. The sts on the MB are dropped before beginning the check, which is the next 4 patt rows. Then the check sts are transferred to the backing so they won't unravel, and remaining background sts between checks are dropped. The sequence is then repeated.
Bottom. Tucked bird's-eye backing. The pattern is vertical white stripes with solid dark background between them. The entire piece is knitted first, in the normal technique for this backing. When knitting is completed, the 2 stripe sts in col 2 (light) and a col 1 st on each side are transferred to the backing and bound off with the backing. The remaining sts between (in col 1) are dropped.

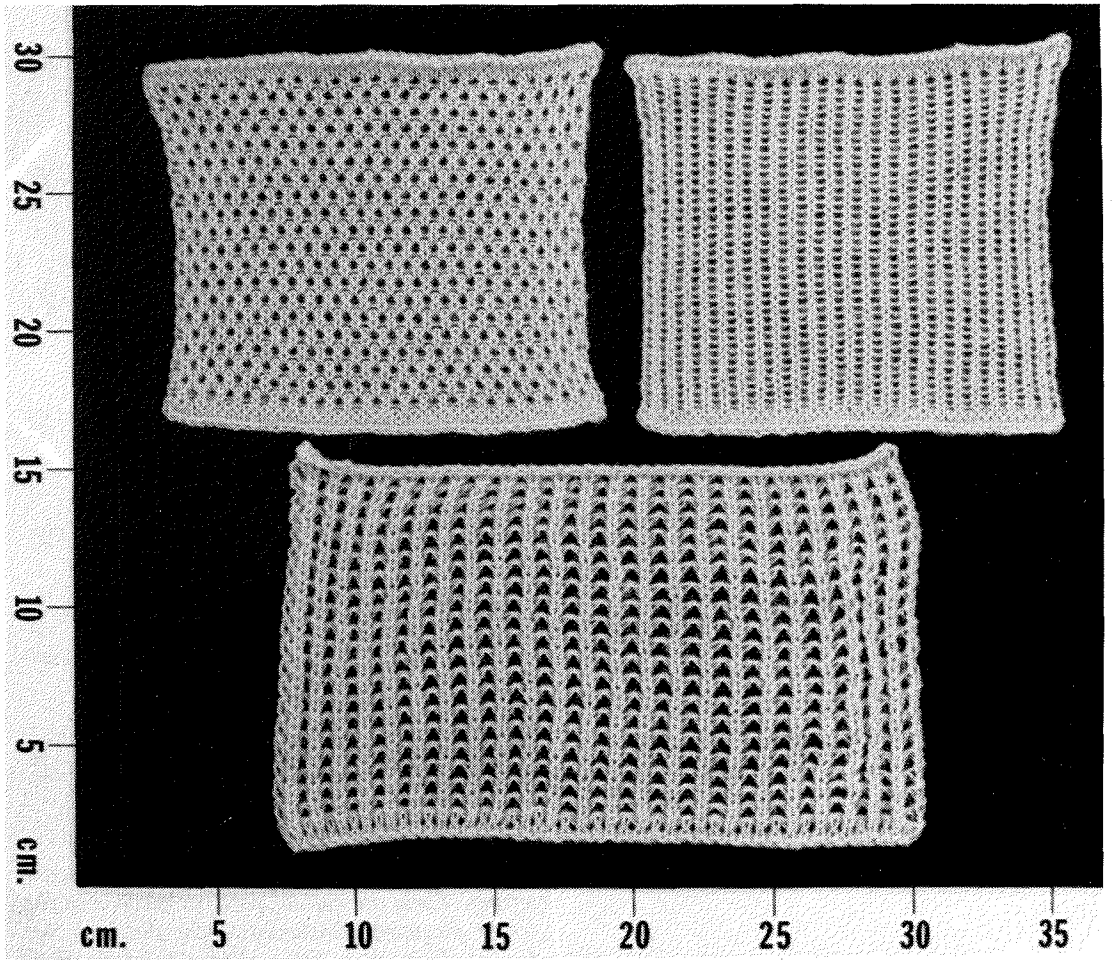
LACE MADE WITH TRANSPARENT THREAD

Sometimes called *punch lace* or *see-through lace*, this fabric requires two yarns: a regular knitting yarn for the lace pattern, and a transparent nylon thread to knit the spaces and hold the lace pattern together. Although the latter is also knitting, it is barely visible and so creates an illusion of open spaces.

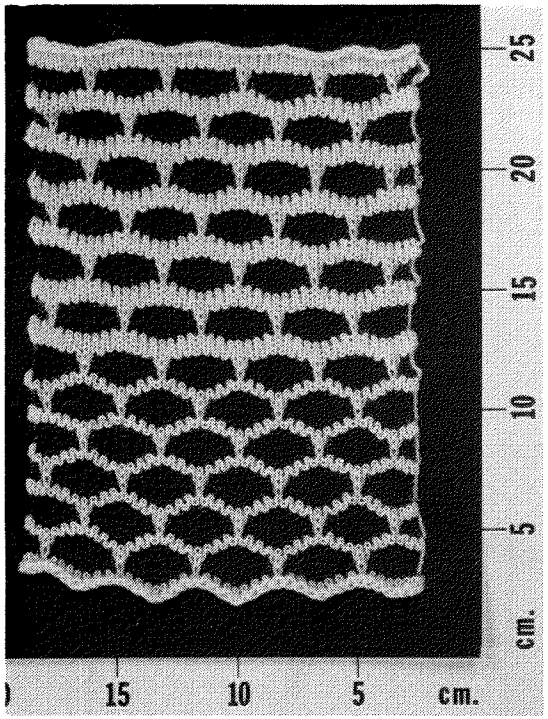
This lace is made by various straightforward two-color knitting techniques; there is no transfer or dropping of stitches. These fabrics are knitted as if both yarns were solid colors, but use of the transparent thread for one of the colors produces different—and unexpected—effects. All kinds of two-color techniques can be used. Single bed slip and tuck patterns, small repeat jacquards, and double bed rib tuck patterns—including racked ones—all result in designs not possible with any other technique.

The Singer/Studio's Punch Lace cam setting was created especially for knitting with transparent thread together with jersey jacquard punchcards. With this setting, the nylon thread in the second feeder is plated on the purl side of the main yarn stitches. This eliminates floats of nylon, while floats of the main yarn show through the nylon stitches and become part of the pattern. The same fabrics can be knitted by standard jersey jacquard techniques on machines without a special cam setting. These fabrics *will* have floats of nylon.

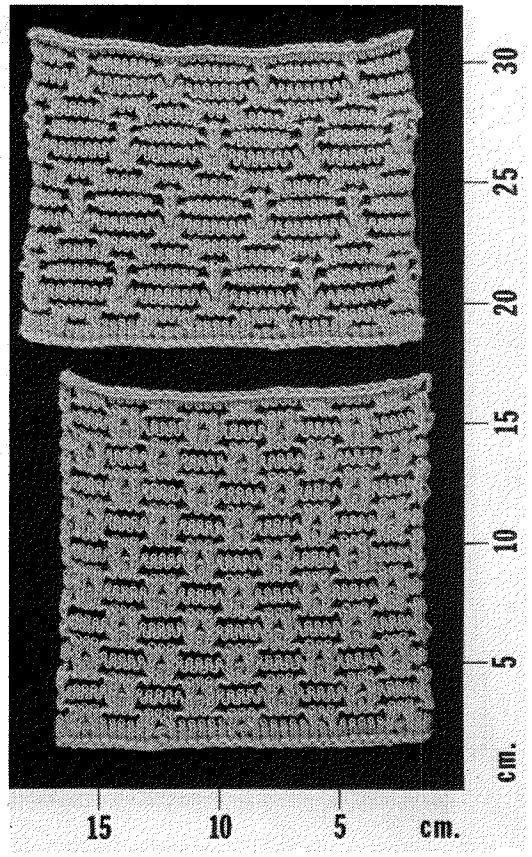
There are other two-color techniques which can be used and which will not create floats of nylon. Mosaic patterns on a knit/tuck setting and all sorts of single and double bed tuck patterns are very successful. Meshes made on a 1x1 slip or tuck setting make very stable fabrics. Search through your pattern books and try any single or double bed two-color pattern that appeals to you.



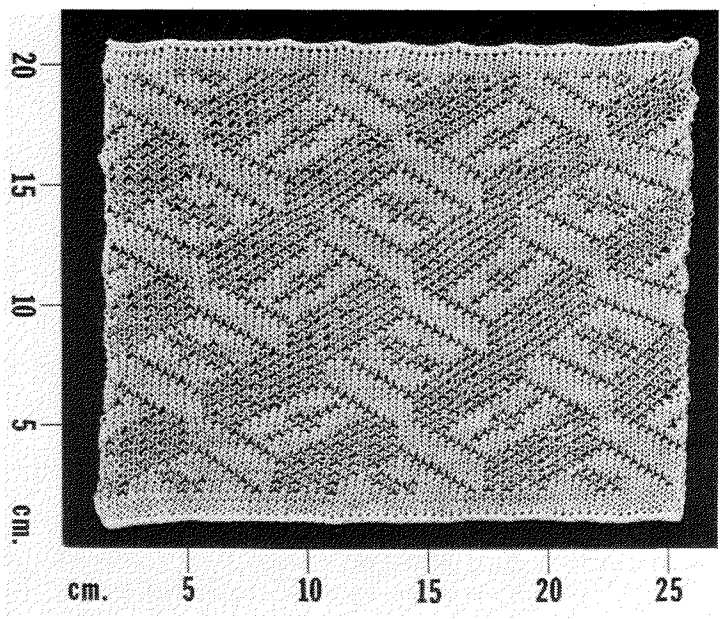
Meshes made with 1x1 needle selection. Selection alternates every 2 pattern rows.
Top left. Knit as jersey jacquard.
Top right. Knit as jersey jacquard, with continuous selection (punchcard stopped).
Bottom. Knit/tuck with selection alternating every 2 rows, using the color changer. The main yarn knits the odd ndls and tucks the even ndls for 2 rows, then the transparent thread tucks the odd ndls and knits the even ndls for 2 rows.



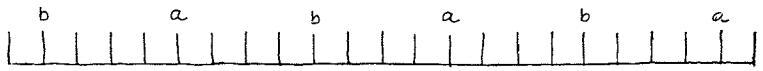
*Honeycomb pattern. With main yarn, cast on the MB and knit 2 or 4 rows. *With* a *ndls tucking and the remainder knitting, knit 6 rows with nylon. With main yarn, knit 2 or 4 rows across all ndls. With* b *ndls tucking and the remainder knitting, knit 6 rows with nylon. Knit 2 or 4 rows with main yarn across all ndls.**



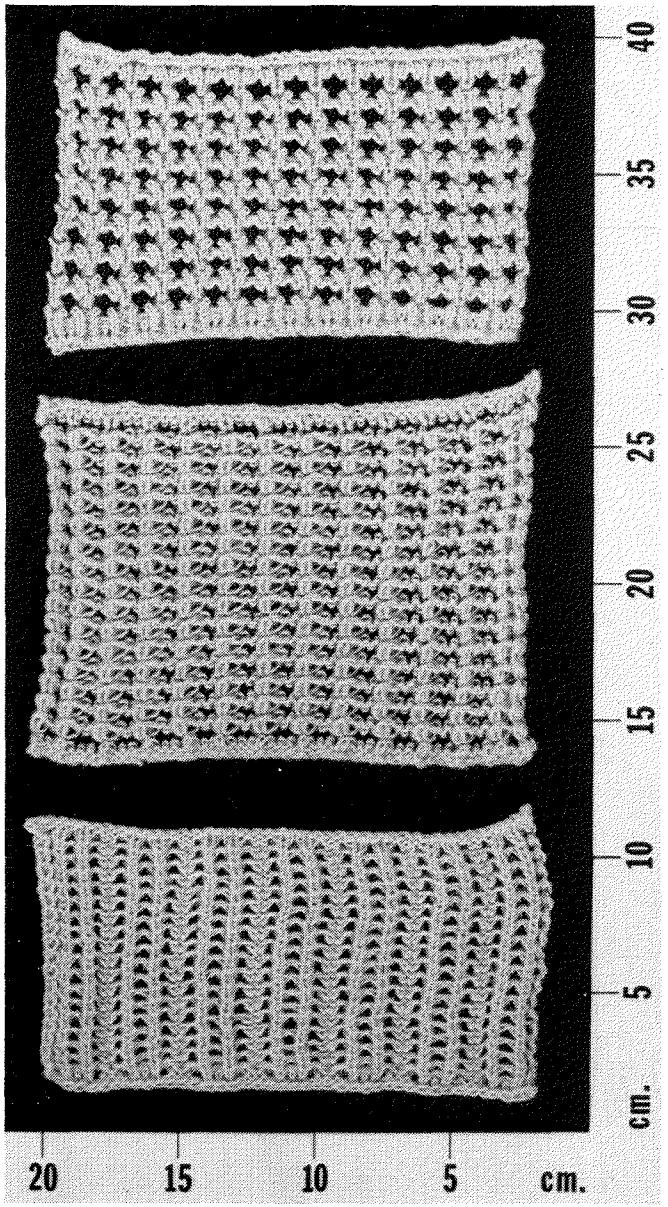
Single bed mosaic patterns made with a tuck cam setting. These are typical patterns made with the jersey jacquard punchcards from the basic set furnished with the machine. (For more information, see the Mosaics chapter.)



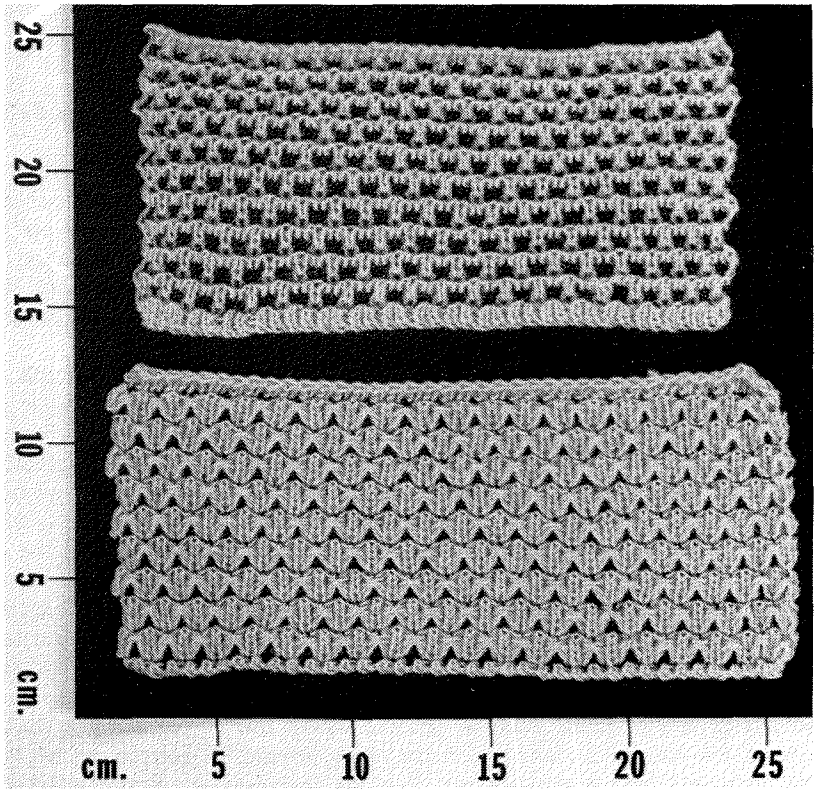
Jacquard Pattern 2, knitted as straightforward jersey jacquard, or with Punch Lace setting on Singer/Studio.



Honeycomb pattern.



In these patterns, nylon is used as the second yarn.



These are two of the same patterns shown in the previous photo, but with nylon used here as the main yarn.

These two photos show double bed two-color knit/tuck patterns from various pattern books. Nylon is substituted for one of the colored yarns.

LACE MADE BY LEAVING NEEDLES OUT OF WORK

The fabrics produced by these techniques may be better known as *tuck lace*, *shawl lace* or *lace-like knitting*. The single or double bed technique of leaving needles out of work during knitting produces two kinds of loosely knitted fabric. In rib-based fabrics, there will be larger-than-normal spaces between groups of stitches; in stockinette-based fabrics there will be "ladders" within the fabric. Both are results of the yarn crossing over empty spaces where needles are left out of work.

The arrangement of working needles, the number left out of work between working needles, size of yarn, and stitch size are all factors in the relative laciness of the fabric. Many lace-like fabrics can be created with regular stitch patterns that use consecutive needles, simply by knitting every other needle and using fine yarn and perhaps a larger stitch size. Even larger openings can be made by leaving two or three needles out of work between working needles.

Such a loosely knitted fabric is quite unstable and will stretch out of shape easily. This quality can be an advantage in flat items such as shawls, where the stretchiness causes the fabric to drape nicely around the shoulders, and eliminates the need for shaping curves.

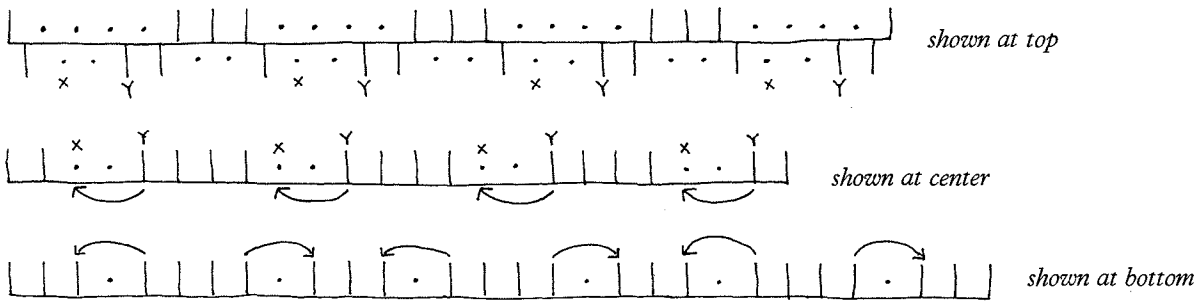
For a more stable fabric, needles can be arranged in groups, or clusters, with three or four needles left out of work and an adjacent group of three or four needles knitting together. The knit stitches will be tighter and will form a more solid area in the fabric, while the yarn crossing over the needles out of work creates the openings. In double bed work, knitting such clusters of stitches with racking pulls the stitches together more compactly and emphasizes the open spaces at the same time.

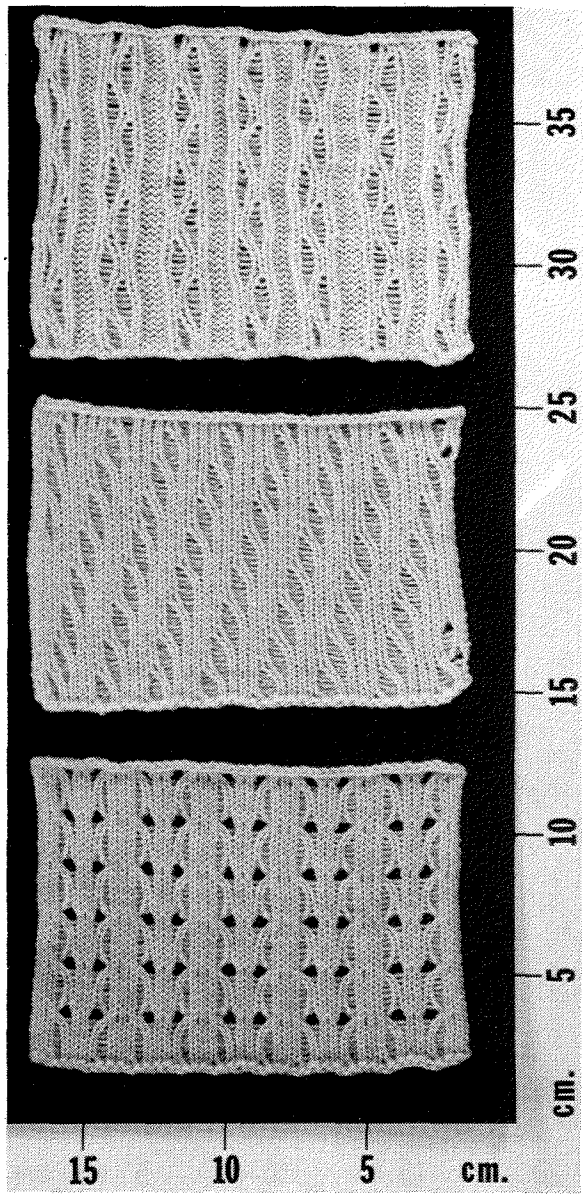
Some form of tuck stitch usually is used in both single and double bed lace patterns. Since the nature of tucking is to pull threads together to make an opening, the combination of tucking on certain needles, clustering groups of stitches, and racking in double bed fabrics, can result in some unusual and beautiful lacy patterns.

The principle of laddering can also be put to good use in designing single bed lacy fabrics. Ladders, which are created either by dropping a stitch and letting it unravel down to the beginning of the knitting, or by leaving a needle out of work so the yarn crosses over the empty space, can make dramatic open designs, especially if the surrounding fabric is fairly solid. A ladder three or four needles wide can be sparked with handwork, such as latching up some of the ladder bars with another color thread, grouping or twisting some with needle and embroidery thread, or weaving ribbons or a different yarn through them. Laddering is also popular for making fringes, braids and trims, and hairpin crochet strips.

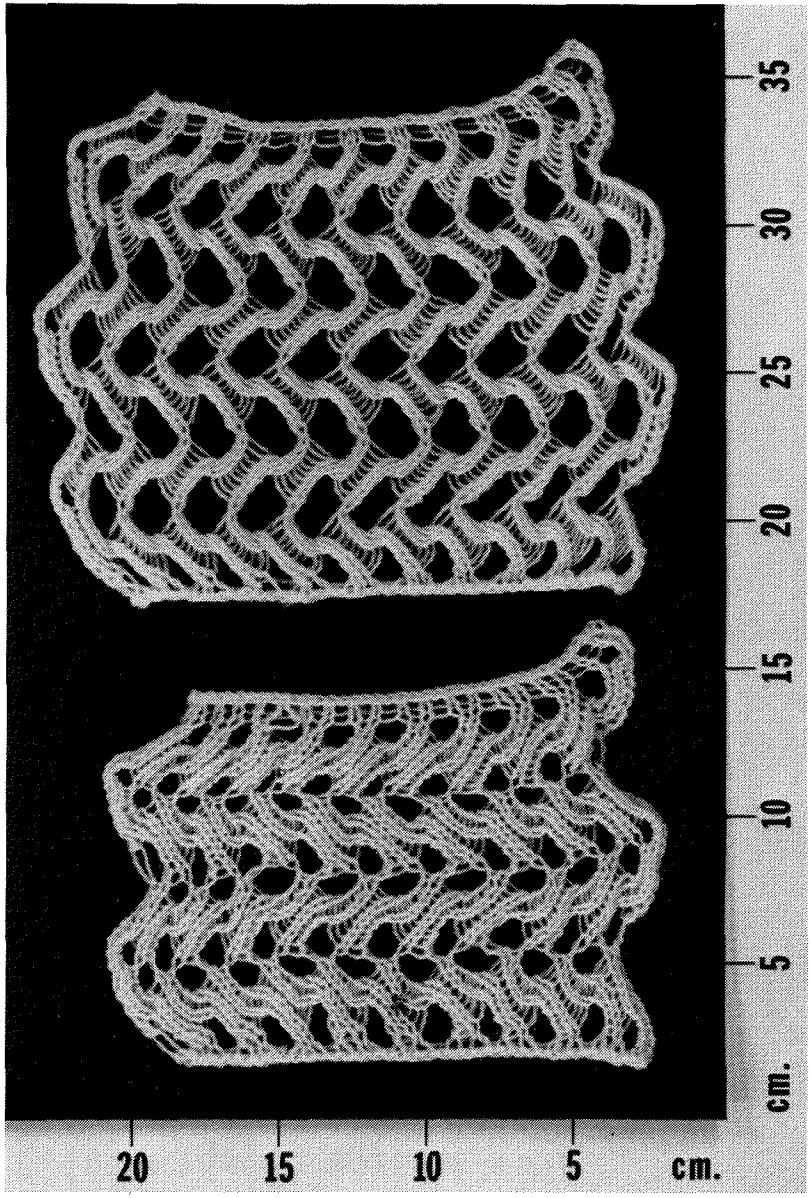
Best of all, this lace method requires neither special equipment nor specific knitting techniques, thus can easily be used in combination with any of the lace techniques we've described. Only your own imagination limits the range of designs that are possible when you combine these lace-like patterns with other laces!

Patterns made by lateral transfer of stitches across needles in NWP. Set carriage to knit all rows.

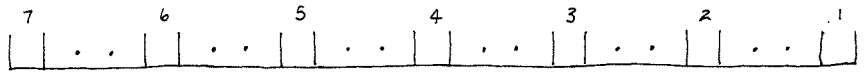




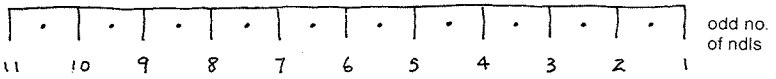
*Top. *Knit 6 rows, transfer st* y *to ndl* x*; ndl* y *to NWP. Knit 6 rows, transfer st* x *to ndl* y*; ndl* x *to NWP.**
*Center. *Knit 6 rows, transfer st* y *to ndl* x*; ndl* y *to NWP. Ndls* x *and* y *now move R by one ndl.**
*Bottom. *Knit 8 rows. Transfer sts in direction of arrows.* Leave empty ndls in WP.*



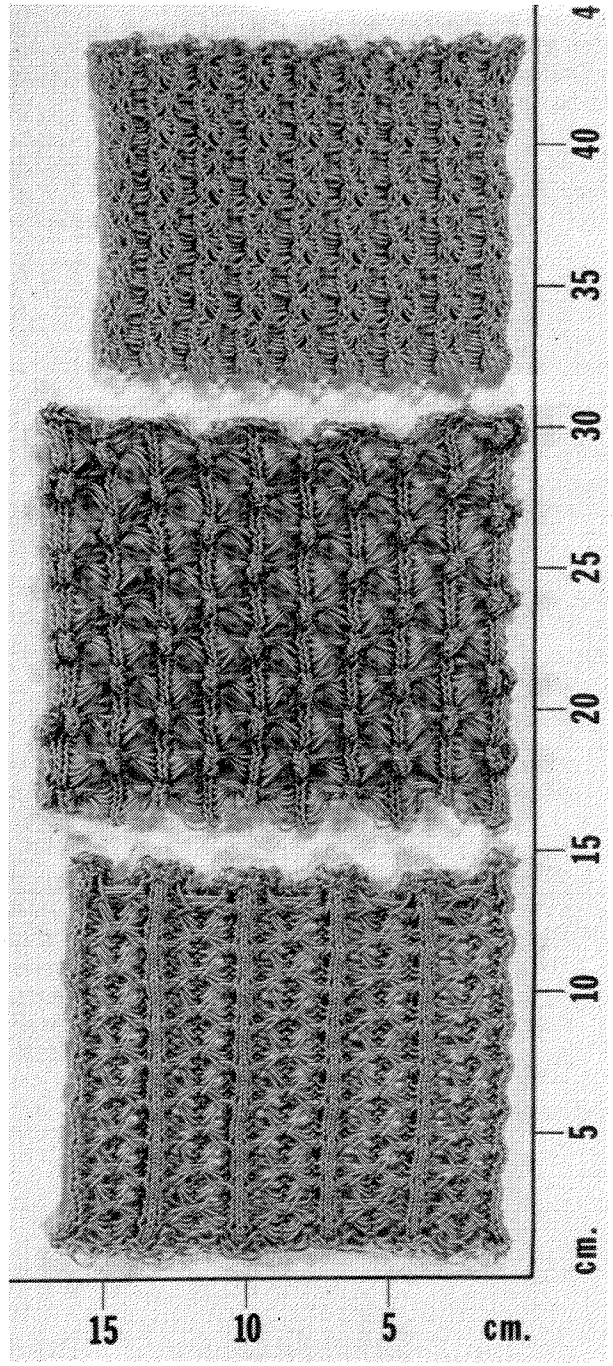
Single bed meshes made by short rows.
Top. Basic short row mesh. All needles work together in pairs. Cast on, end with carr R; put all ndls in HP. Set carr to knit ndls in WP and hold those in HP. Repeat the following two rows:
Row 1 (carr R): Pair 1 to WP, RC8. Pair 2 to WP, RC8. Pair 3 to WP, RC1. Pair 1 to HP, RC7. Pair 4 to WP, RC1. Pair 2 to HP, RC7. Pair 5 to WP, RC1. Pair 3 to HP, RC7. Pair 6 to WP, RC1. Pair 4 to HP, RC7. Pair 7 to WP, RC1. Pair 5 to HP, RC8 (carr L). Pair 6 to HP. Pair 7 remains in WP.
Row 2 (carr L): Pair 7 in WP, RC8. Pair 6 to WP, RC8. Pair 5 to WP, RC1. Pair 7 to HP, RC7. Pair 4 to WP, RC1. Pair 6 to HP, RC7. Pair 3 to WP, RC1. Pair 5 to HP, RC7. Pair 2 to WP, RC1. Pair 4 to HP, RC7. Pair 1 to WP, RC1. Pair 3 to HP, RC8 (carr R). Pair 2 to HP. Pair 1 remains in WP.
Bottom. One of many possible variations of the mesh above. Cast on, end with carr R; put all needles in HP. Set the carriage to knit needles in WP and hold those in HP. Repeat the following two rows:
Row 1 (carr R): ndls 1 and 2 to WP, RC8. Ndls 3 and 4 to WP, RC8. Ndls 5 and 6 to WP, RC1. Ndls 1 and 2 to HP, RC7. Ndls 7 and 8 to WP, RC1. Ndls 3 and 4 to HP, RC7. Ndls 9 and 10 to WP, RC1. Ndls 5 and 6 to HP, RC7. Ndl 11 to WP, RC1. Ndls 7 and 8 to HP, RC8 (carr L). Ndl 9 to HP.
Row 2 (carr L): Ndls 11 and 10 to WP, RC8. Ndls 9 and 8 to WP, RC8. Ndls 7 and 6 to WP, RC1. Ndls 11 and 10 to HP, RC7. Ndls 5 and 4 to WP, RC1. Ndls 9 and 8 to HP, RC7. Ndls 3 and 2 to WP, RC1. Ndls 7 and 6 to HP, RC7. Ndl 1 to WP, RC1. Ndls 5 and 4 to HP, RC8 (carr R). Ndl 3 to HP.



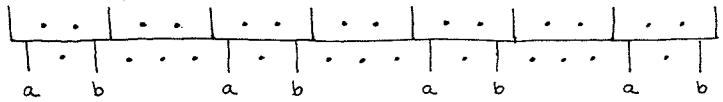
Set-up for swatch shown at top in the photo.



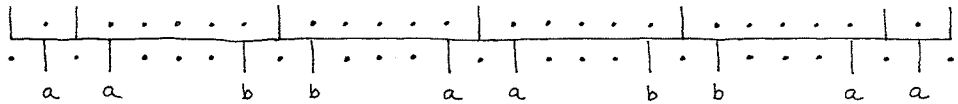
Set-up for swatch shown at bottom in the photo.



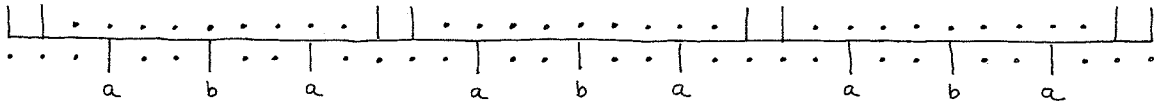
Double bed patterns made without racking.
*Top. *Knit 2 rows plain across all ndls. Set back carr for knit, front carr for tuck. Knit 4 rows with* a *ndls tucking and* b *ndls knitting.* Repeat, switching* a *and* b *ndls.*
*Center. *Set back carr for knit, front carr for tuck. With col 1, knit 6 rows, with* a *ndls tucking and* b *ndls knitting. With col 2, knit 2 rows plain across all ndls.* Repeat, switching* a *and* b *ndls.*
*Bottom. Set back carr for knit, front carr for tuck. *Knit 4 rows with* a *ndls tucking and* b *ndls knitting. Knit 4 rows with* a *ndls knitting and* b *ndls tucking.**



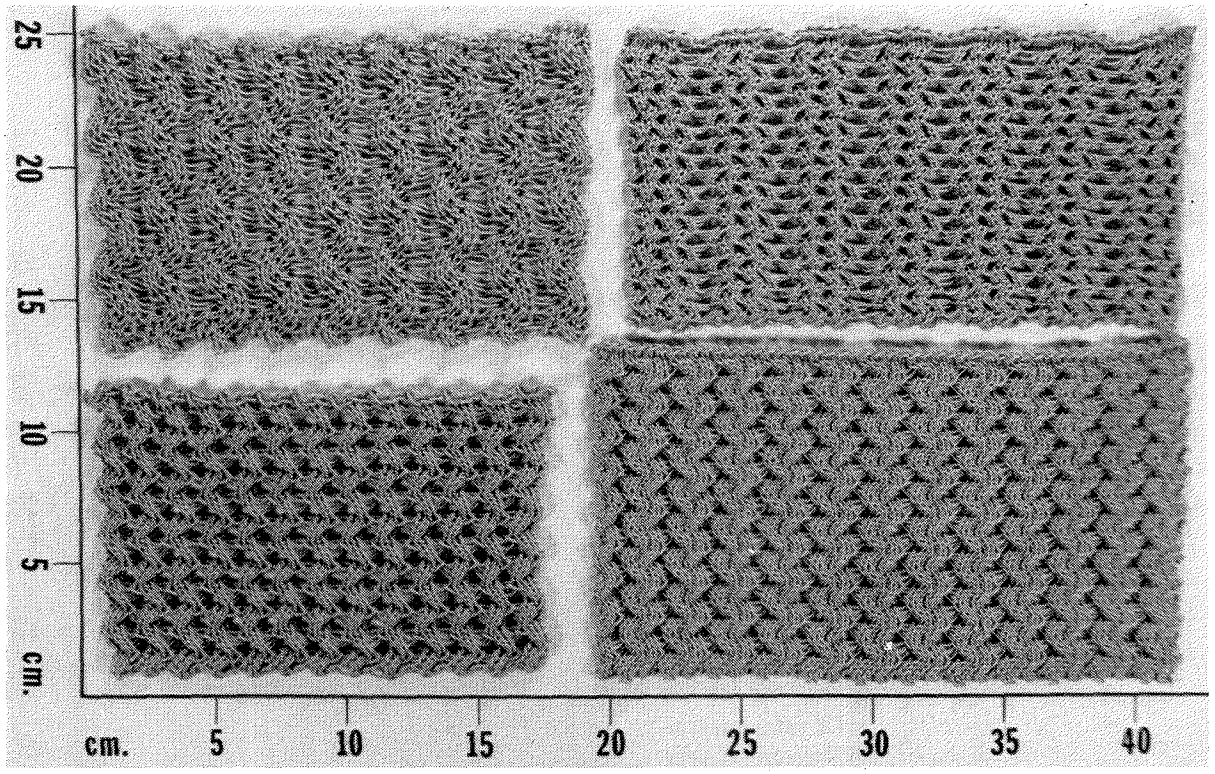
Set-up for swatch shown at top in the photo.



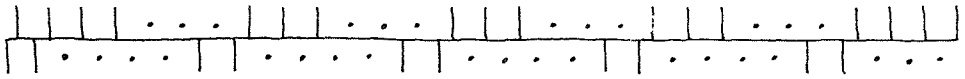
Set-up for swatch shown at center in the photo.



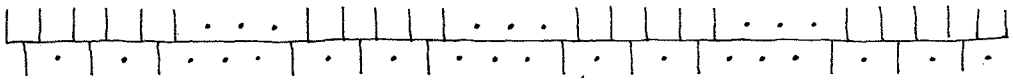
Set-up for swatch shown at bottom in the photo.



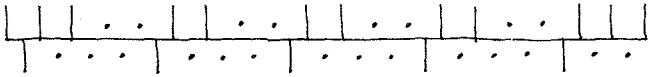
Double bed racked patterns. The first rack on Passap is to the left; to the right on other machines.
*Top left. Set back carr for knit, front carr for fisherman's rib. Cast on; knit 2 rows. *Rack one ndl; knit 2 rows* 4 times in the same direction. *Rack one ndl back again; knit 2 rows* 4 times in the same direction. Repeat the entire sequence.*
*Top right. *Set back carr for knit, front carr for tuck; knit 3 rows, rack one ndl, set both carr for knit; knit one row. Set back carr for knit, front carr for tuck; knit 3 rows, rack one ndl back. Set both carr for knit; knit 1 row.**
*Bottom left. *Set back carr for knit, front carr for tuck; knit 4 rows, rack one ndl. Set both carr for knit; knit one row, rack one ndl same direction, knit one row.* Repeat, racking next sequence in opposite direction.*
*Bottom right. Set back carr for knit, front carr for tuck. *Knit 4 rows with* a *ndls tucking and* b *ndls knitting. Rack 2 ndls. Knit 4 rows with* b *ndls tucking and* a *ndls knitting. Rack 2 ndls back again.**



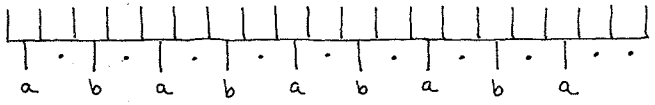
Set-up for swatch shown at top left in the photo.



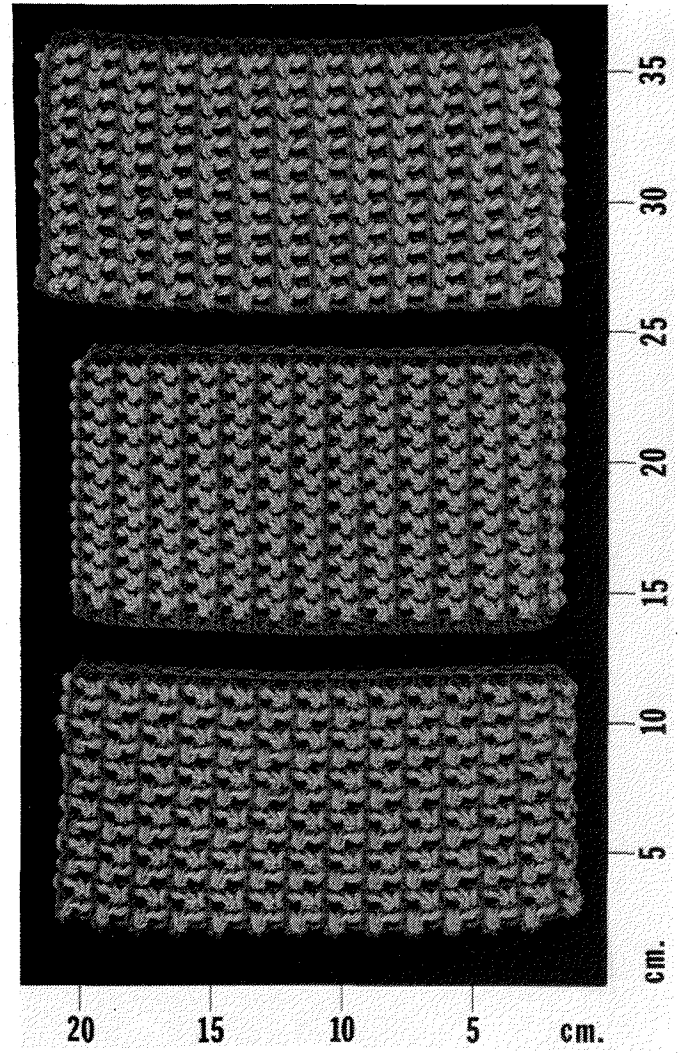
Set-up for swatch shown at top right in the photo.



Set-up for swatch shown at bottom left in the photo.



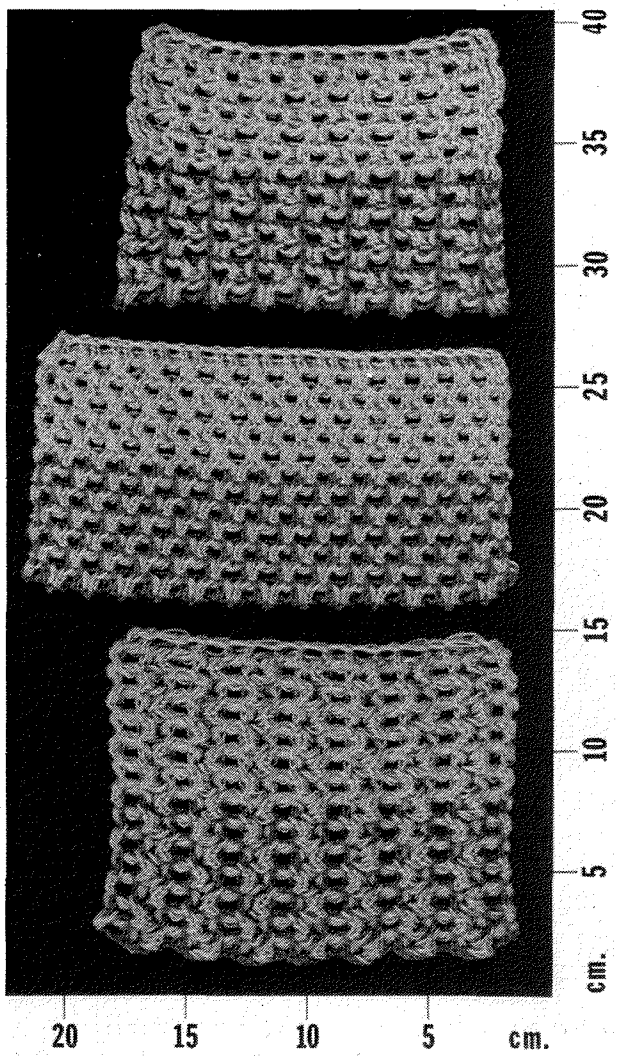
Set-up for swatch shown at bottom right in the photo.

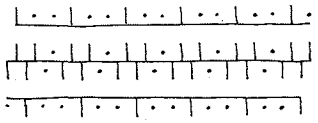


Cross-tuck "crochet" patterns for Passap. The basic pattern is shown at top in the photo above; the other swatches are variations. These patterns can be knitted in one or two colors. For a straight lower edge, make a tubular cast-on, or cast on with racking. For a picot edge, just knit 2 rows across all ndls without racking. In these six swatches, all racks are by one needle.

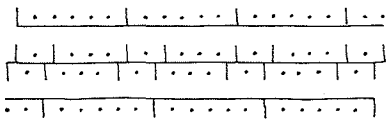
*Top left. *Set both carr AX; knit 4 rows, rack L. Set both carr N; knit 2 rows, rack R.**
*Center left. *Set both carr N; knit 2 rows, rack L. Set both carr AX, knit 4 rows, rack R.**
*Bottom left. *Set both carr N; knit 2 rows. Set both carr AX; knit 4 rows, rack L. Set both carr N; knit 2 rows. Set both carr AX; knit 4 rows, rack R.**

*Top right. *Set both carr N; knit 2 rows. Set both carr AX; knit 4 rows, rack L. Set both carr N; knit 2 rows. Set both carr AX; knit 4 rows, rack R.**
*Center right. *Set both carr AX with no arrow keys; knit 4 rows, rack L. Set both carr N with left arrow keys; knit 2 rows, rack R.**
*Bottom right. *Set both carr AX with no arrow keys; knit 6 rows, rack L. Set both carr N with left arrow key on front carr only; knit 1 row, rack R; knit 1 row, rack L. Set both carr AX with no arrow keys; knit 6 rows, rack R. Set both carr N with left arrow key on front carr only; knit 1 row, rack L; knit 1 row, rack R.**

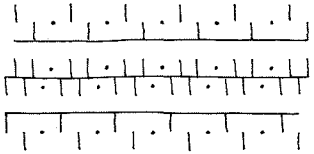




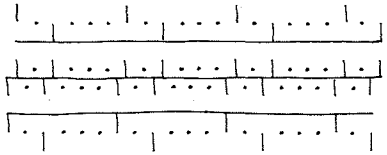
Set-up for the swatches shown above.



Set-up for top swatch in the photo at right.



Set-up for center swatch in the photo at right.

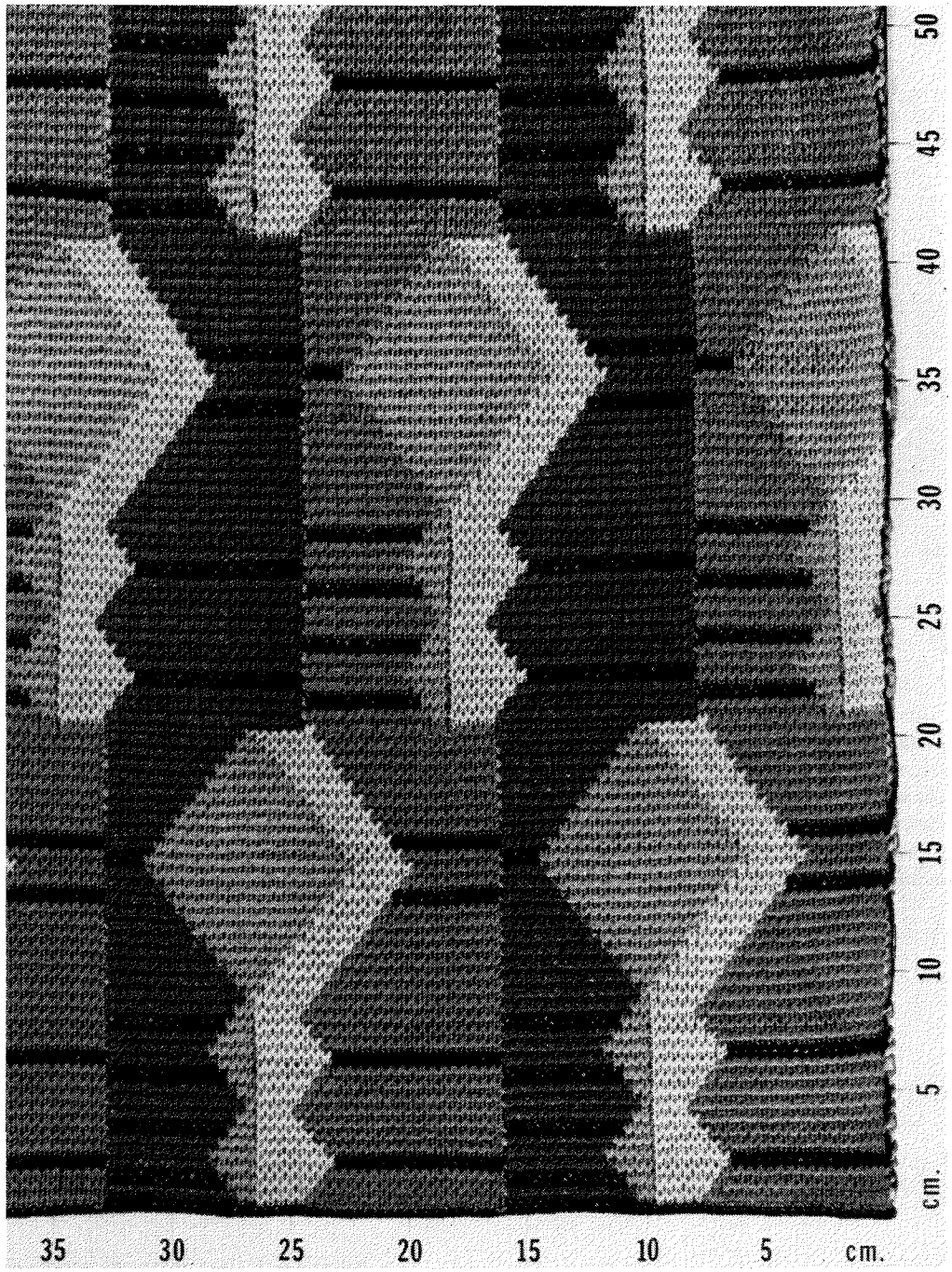


Set-up for bottom swatch in the photo at right.

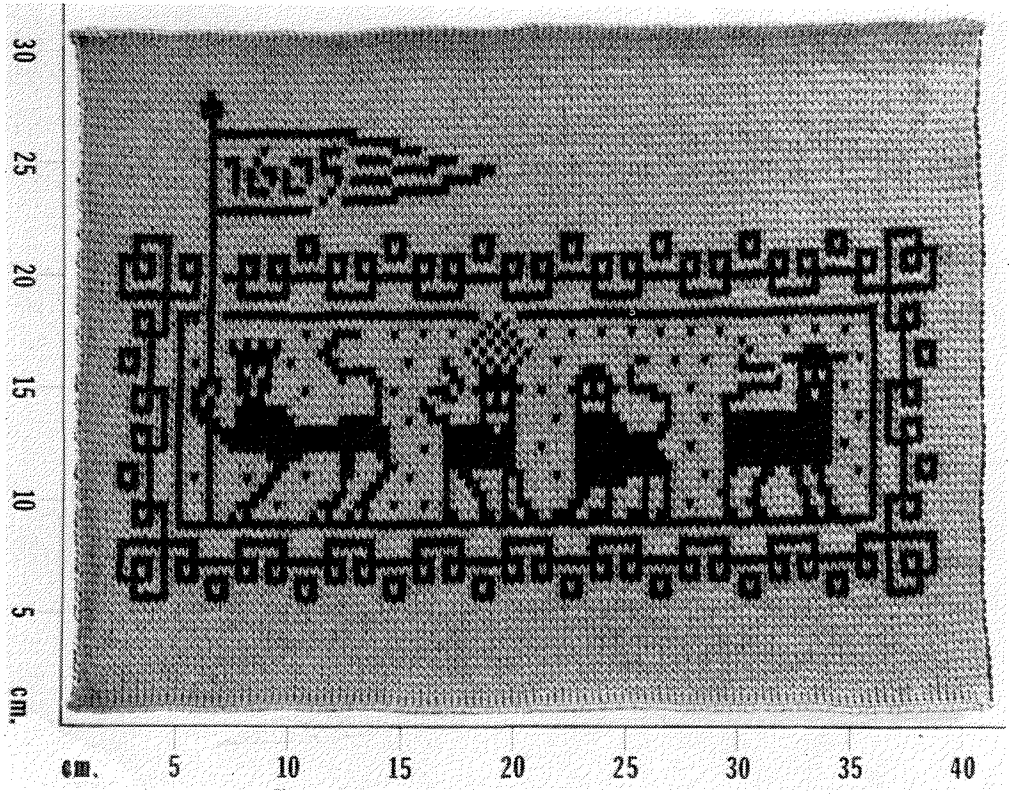
CHAPTER 15
Afterthoughts

In the introduction to this book we said the subject of machine knitted fabrics is a never-ending one. It's true! This last chapter is not an instructive chapter in the sense that the others are, but is a gallery of fabric portraits. It is a small collection of ideas which came to us after the preceding chapters were written. Some of the fabrics shown here are new constructions, some were mentioned in the text but not illustrated, and some are ideas for variations, which sprouted after we read our own words!

New fabric constructions and variations are created continuously, both from mistakes which turn into successes and from carefully planned experiments. The world of machine knitted fabrics continues to grow and evolve as technology advances, as we broaden and fine tune our knowledge and skills and as we develop the courage to step away from "words writ in stone" and begin to make our own observations and discoveries. This chapter, then, serves as an example of how we hope *you* will use this book.

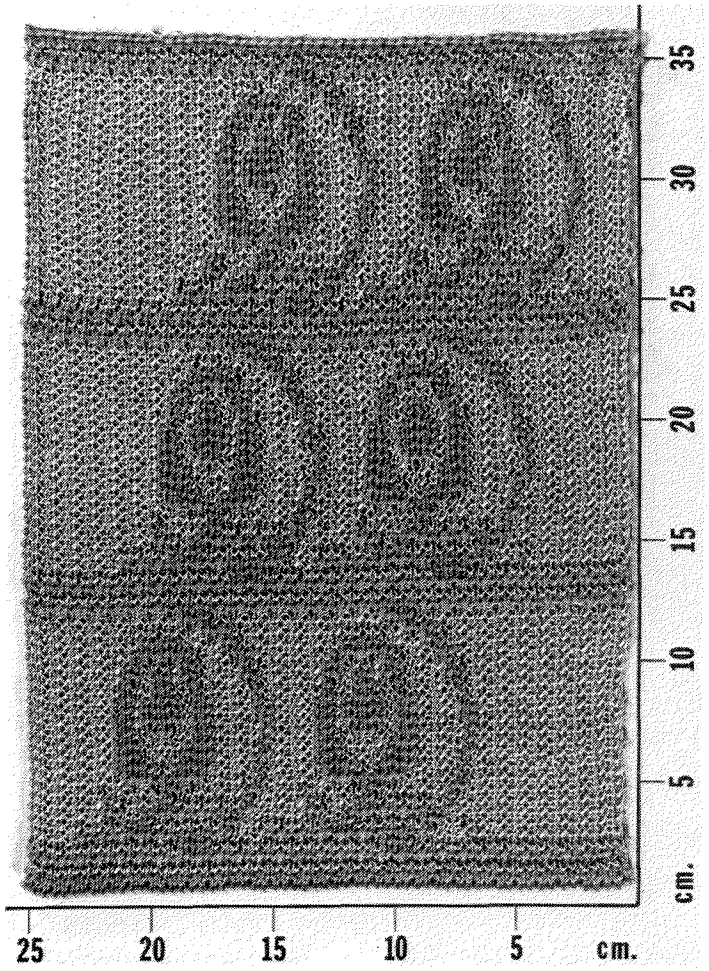


Intarsia Pattern 4, knitted as rib jacquard, modified weft with striper backing, and with four colors per row. Another example of this fabric type can be found at the end of the Jacquard chapter. Since all four colors are represented in every pattern row, this particular intarsia design will make a Type D punchcard that is also suitable for rib jacquard. In the second rotation of the card, the repeat was moved to the right by half a repeat so the floating shapes would alternate. The two background colors, 1 and 4, alternate with a fifth color on some rows. These two colors also change places in the second card rotation, so the vertical background stripe will remain constant.

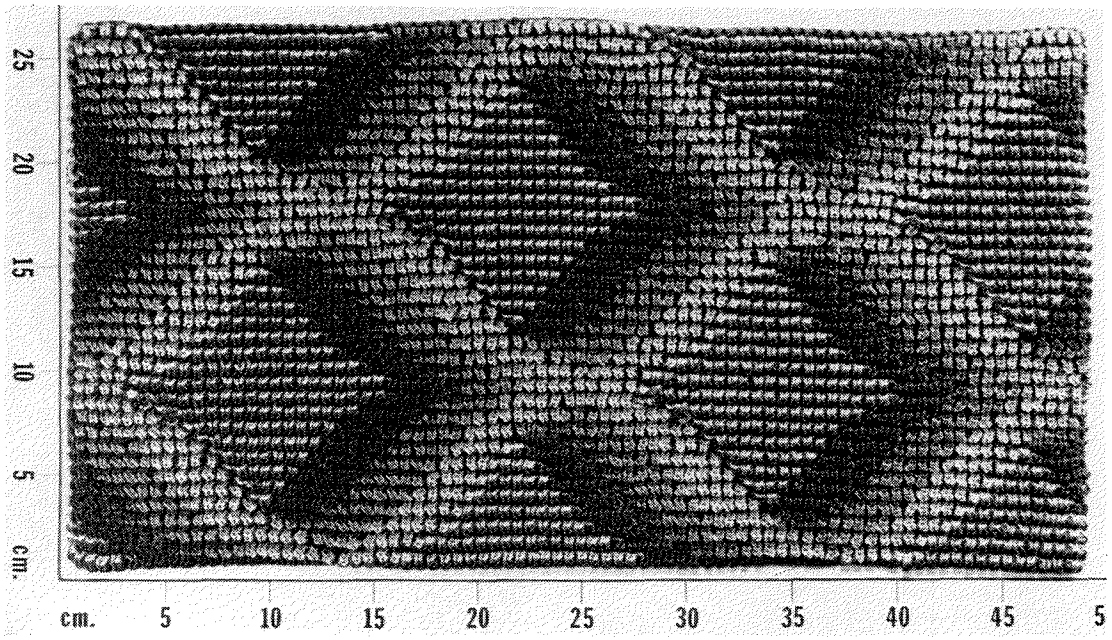


Motif pattern made with a Jac 40. The motif is 120 stitches wide. Each 120-stitch pattern row requires three punchcard rows, with a 40-stitch section of the repeat on each punched row. To select the needles, select the first third with the first punched row, the second third with the second punched row, and the remaining third with the third punched row. Then knit the row, and repeat the process for each pattern row. This fabric is knitted in rib jacquard, in half Milano technique. The design is adapted from a piece of Italian needlework dated 1605.

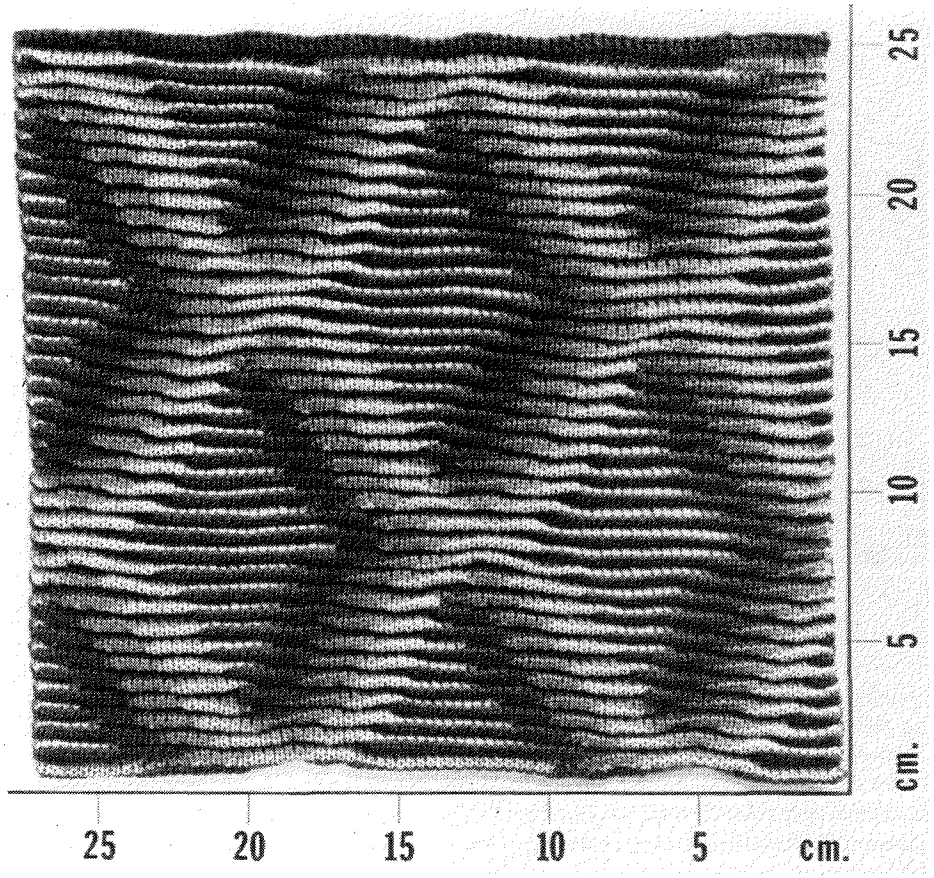
Two different patterns knitted simultaneously. This swatch illustrates a combination of automatic punchcard selection (jacquard Pattern 6) and Jac 40 selection (jacquard Pattern 8). The areas for the Jac 40 selection are isolated on the needlebed with isolation cams: the Jac 40 with its punchcard can then select for the second pattern. The fabric is knitted in rib jacquard with bird's-eye backing. Another example of this technique can be seen in the swatch of the mosaic tree pattern in this chapter.



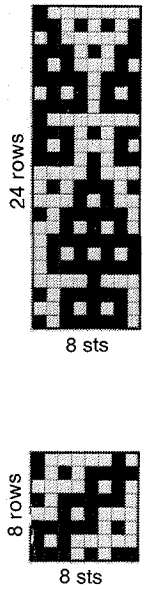
Another variation of the tucked bird's-eye shown in the Jacquard chapter, made with jacquard Pattern 10. On the backing bed, knit even needles and tuck odd needles on row 1; knit all needles on row 2. In the next sequence, the knit/tuck selection from the first backing row is reversed. Four rows = 1 complete sequence. On Passap, use a Type A card with Deco 4, on other machines use Type C-1 card with EOR rotation, or Type C-2 card with ER rotation. The swatch is knitted with a rayon yarn for the background, and a wool yarn of the same color for the design.

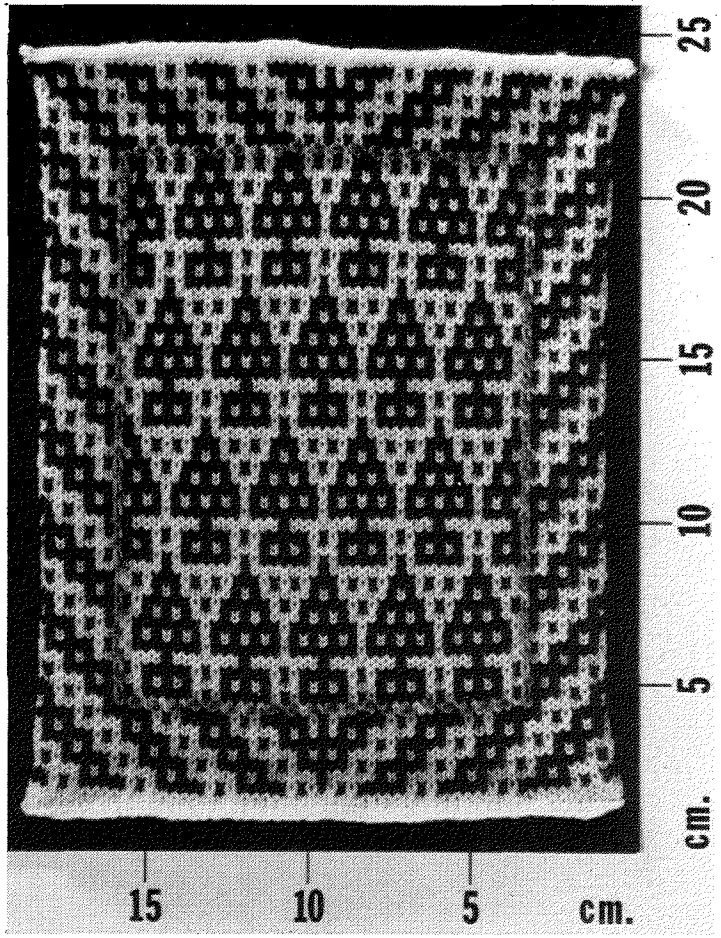


Rib jacquard, basic tuck in four colors per row, made with jacquard Pattern 14. This fabric is illustrated in the Jacquard chapter, but here the backing side is the right side of the fabric. Because the color areas shift between the face and backing, the order of knitting the four colors must be changed in the color changer. Thread color 4, the background or main color, as color 2; color 1 (light) as color 3; color 2 (medium) as color 4; color 3 (dark) as color 1. Now each color will appear in its proper place in the design on the reverse of the fabric. In the second card rotation of this swatch, knitted on Passap, the punchcard was shifted by half a repeat to the right, but was not turned upside down or backward. It was returned to the original location for the third rotation.

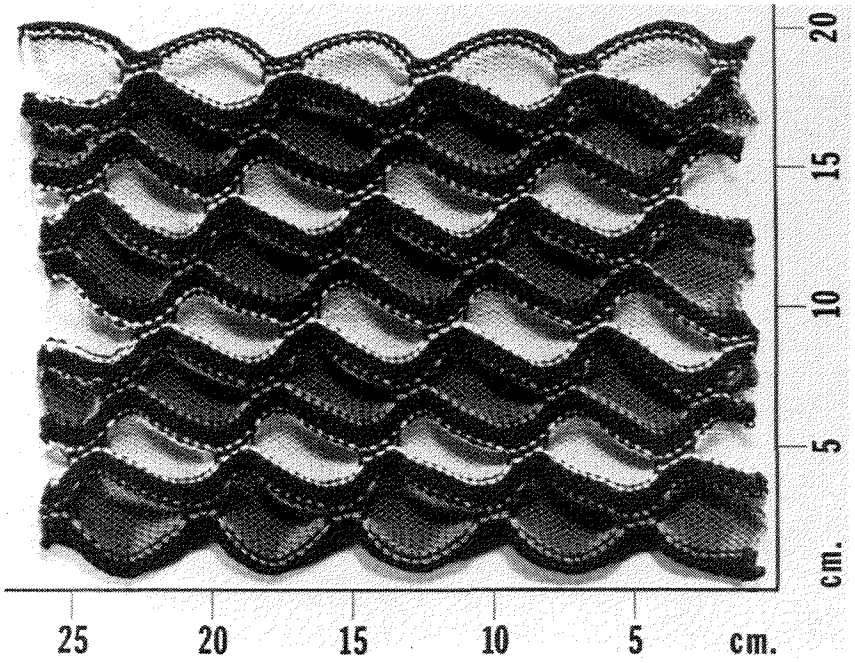


Rib Jacquard, half Milano backing in four colors per row, made with jacquard Pattern 14. This fabric also is illustrated in the Jacquard chapter, but here the backing side is used as the right side. In this swatch, too, there is a color shift between the face and backing. Thread color 4, the background or main color, as color 1, and the three ribbon colors (light, medium, dark) as colors 2, 3, and 4. As in the previous swatch, the punchcard was shifted half a repeat for the second card rotation.

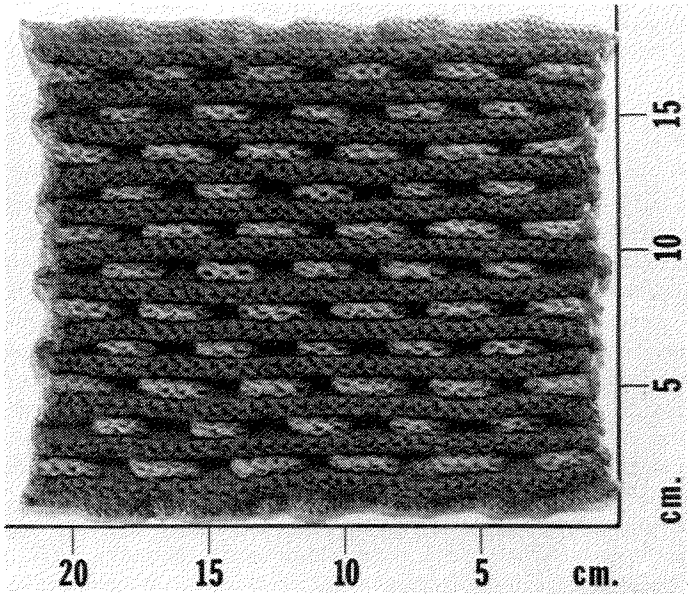


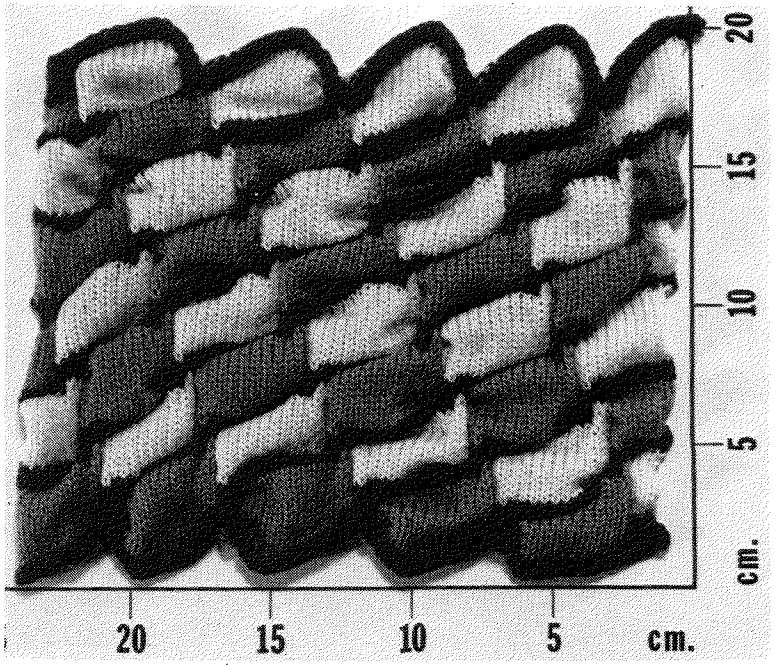


Two mosaic patterns knitted simultaneously. The tree pattern was put in the card reader on the machine, with a border area on each side isolated with isolation cams. The border pattern was then selected with a Jac 40. Both patterns are Group 1 mosaics; the graphs for the patterns are next to the photo. Follow the directions in the section Designing Your Own Mosaics, at the end of the Mosaics chapter, to translate the graphs to punchcard. The swatch was knitted single bed with a slip cam setting. The beaded decoration was added after knitting. Another example of this technique is the "airplane and lightning bolt" swatch shown in this chapter.



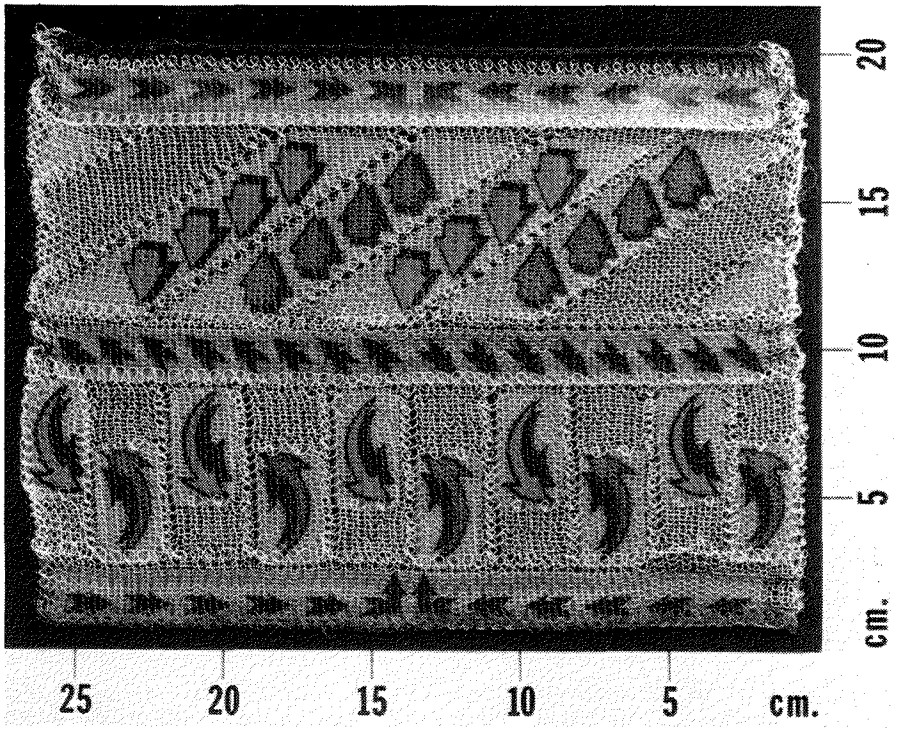
*Single bed ripple pattern made by manually hanging stitches from rows below onto needles. Although the purl side of the fabric is shown, the knit side is very interesting, too. Two colors alternate for the main part of the fabric (light), separated by four rows of a third color (dark). Set cams for stockinette throughout. *Knit 4 rows with col 3. Knit 14 rows with col 1 or 2. Beginning at either left or right selvedge, with a transfer tool pick up a stitch from the last col 3 row below, and hang on the same ndl above. Repeat with 3 more adjacent sts (4 adjacent sts total). Skip 12 needles and pick up 4 more sts the same way. Repeat across the row.* On subsequent sequences, shift the groups of 4 sts that you pick up from the last row of col 3 below either left or right by 4 needles from the previous repeat, so they move diagonally up the fabric.*



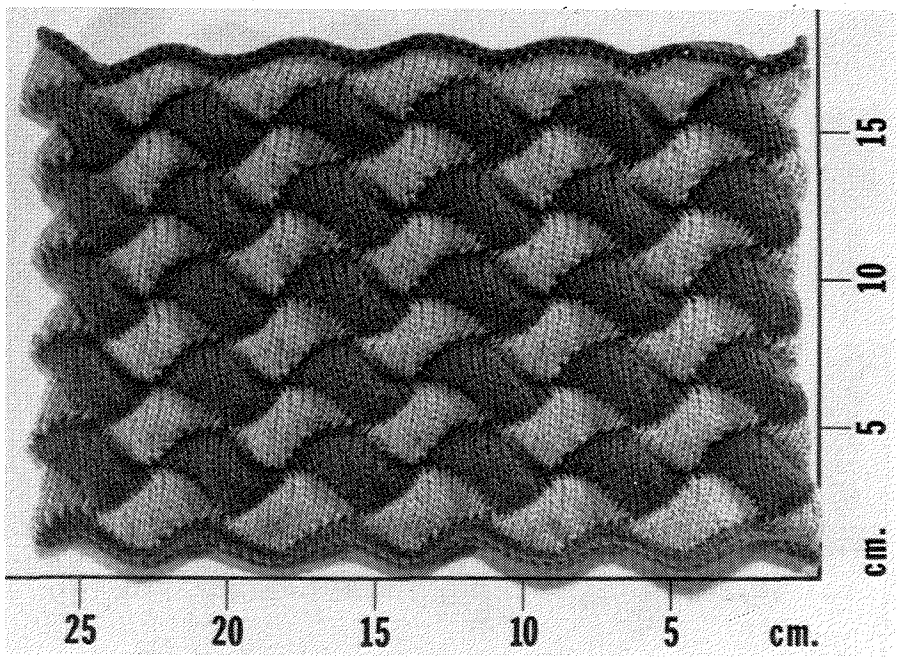


*This fabric is similar to the one shown at left, but is made by knitting and slipping groups of stitches. It is knitted single bed, with two colors for the main part of the fabric and four rows of a third color to separate them. It is best to weight each section of the fabric separately with small claw weights. Set cams for slip throughout. On Passap, use pushers to select manually for pattern; on other machines, a punchcard is best. Cast on and knit four rows in col 3. *First sequence, with col 1 or 2: select 12 ndls to knit alternating with 4 to slip for 14 rows (same selection all 14 rows). Second sequence, with col 3: moving the selection left or right by 2 ndls from previous selection, select 12 ndls to knit alternating with 4 to slip for 4 rows (same selection all 4 rows).* Before knitting first sequence again, move selection by 2 more ndls in same direction as before. This move by 2 ndls occurs with every color change, making patt move diagonally up the fabric.*

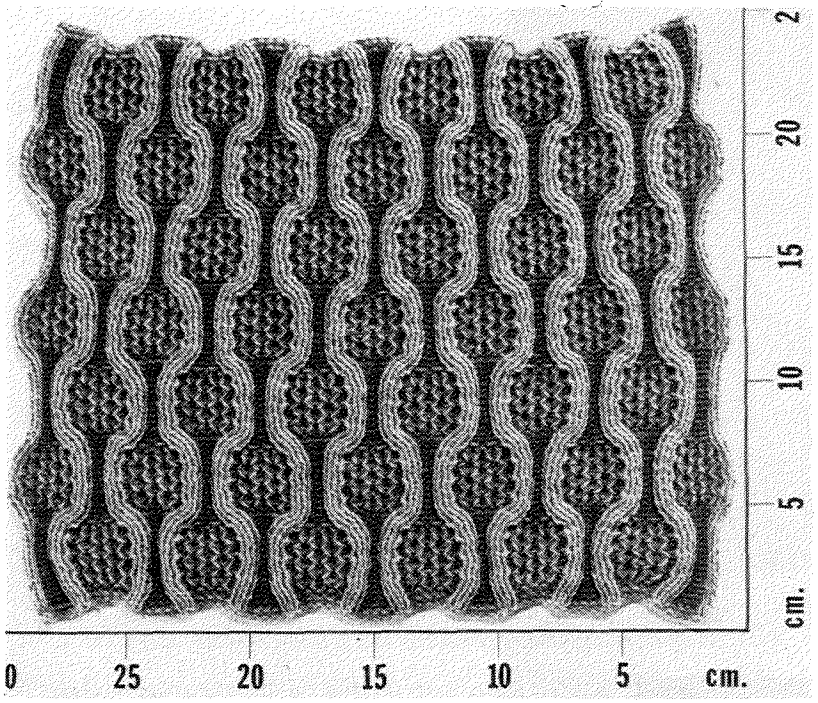
Tea cozy stitch, as the British sometimes call it, is another pin tuck fabric. It is made with the technique used on Passap to knit purl stitch mock rib hems. This version is for all machines, and is knitted single bed. Cast on the MB and knit a few rows. Make pin tuck by selecting and knitting only odd numbered ndls for 8 to 10 rows (punchcard 1 from the basic pack, locked on a row), while even ndls slip. Then knit several rows in stockinette on all ndls to lock ripple in place and form a backing before next ripple is begun. To break ripple into pieces (shown on alt patt rows in swatch), allow groups of 3 or 4 adjacent ndls to knit. These form part of the backing; alternating ndl selection between them forms a narrow pin tuck.



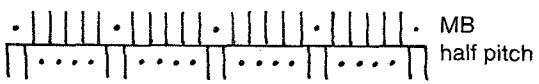
Translucent quilting, from Chapter 5, Double Fabrics. The pattern given for the eight-lock and quilting samplers is used here for a special-effect fabric. Color 1 is sewing cotton, color 2 is transparent nylon thread. Little arrows painted on matte acetate are inserted in the pockets before closing. The eight-lock technique is also suitable.



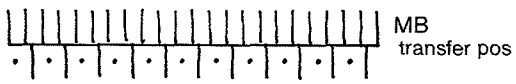
Entrelacs made by short rows. This is another version of the popular handknitting pattern, and resulted from efforts to find an easy way to duplicate the handknitted version on the machine. It is not quite the same as true entrelacs, but still makes a nice fabric. Refer to the key in Chapter 10, Short Rows, and follow these instructions: A4, B3, B4, C2, D5, E9, F5.



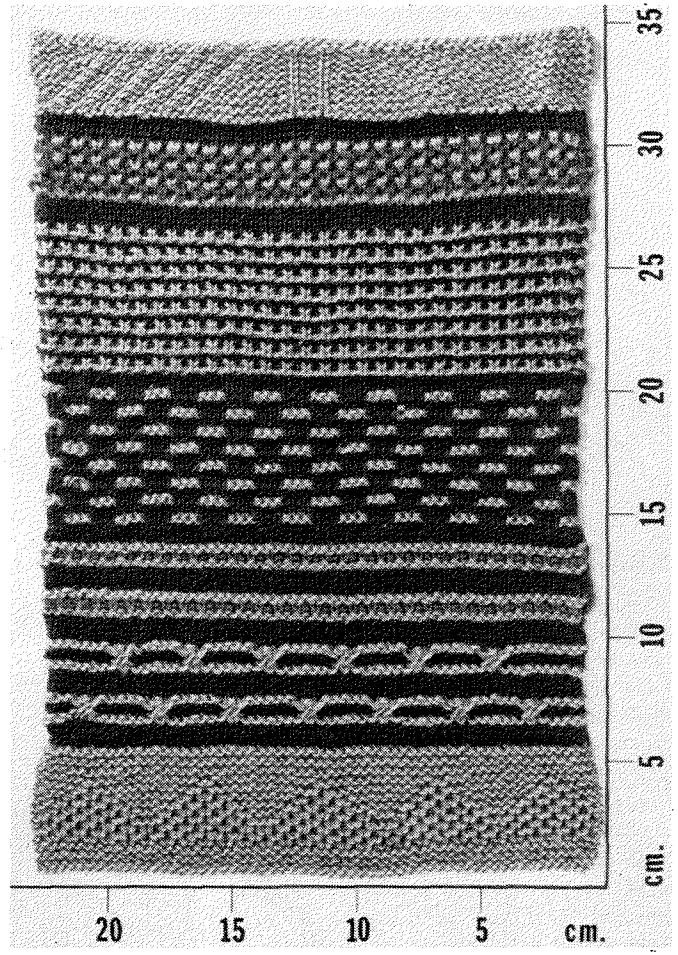
Rib pattern with tuck stitch and plating. This embossed, plated fabric is knitted straight, with the needle set-up shown. The waves in the ribs result from the patterning on the main bed: alternate groups of main bed needles knit in a 1x1 knit/tuck pattern for 16 rows, then repeat with the opposite, alternate groups in the next sequence. The rib needles knit straight throughout. In the finished fabric, the knit/tuck portions of the fabric push the ribs outward while the plain portions pull the ribs inward, creating the waves.



Set-up for rib pattern with tuck stitch and plating.



Set-up for pattern 5 of the garter stitch sampler.



Garter stitch sampler. This little sampler illustrates some simple patterning ideas in garter stitch, several of which are adapted for modern machines from a stitch pattern book for the Passap-D, manufactured from 1950 to 1954. It was Passap's second wooden knitting frame, and knits in both garter stitch and stockinette with equal ease. Instructions for knitting the patterns, beginning at the bottom of the sampler:

*Pattern 1. Knit 2 ribs (4 rows garter stitch). *With a work hook, pull up a purl stitch from the rib below and hang on the needle above with the present stitch. The pulling up must be done on alternate needles only; to do it on adjacent needles will result in unknitted stitches. Knit 1 rib (2 rows).* Repeat.*

Pattern 2. Knit some rows in stockinette with col 1. With col 2, knit 1 rib of garter stitch, then 2 rows of stockinette with col 1, then the first row of the next garter rib in col 2. With a work hook, pick up two purl stitches, spaced 1 stitch apart, from the rib below. Cross them, and hang on the needles above. Finish last row of garter rib; repeat from the start.

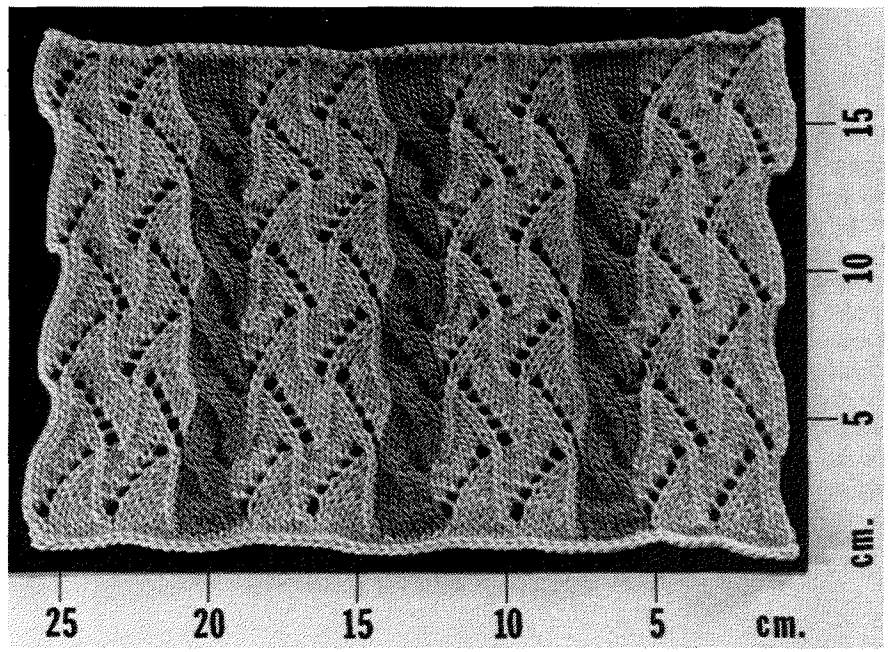
Pattern 3. Knit 1 garter rib. Select alternate needles and knit 1 garter rib in another color on the alternate needles alone, allowing the non-selected needles to slip. Knit another garter rib on all needles, the same as the first.

*Pattern 4. *With col 1, knit 2 rows stockinette on all sts. In col 2, knit 1 garter rib on alternating groups of 3 ndls; cams set for slip.* Floats will be on purl side of fabric.*

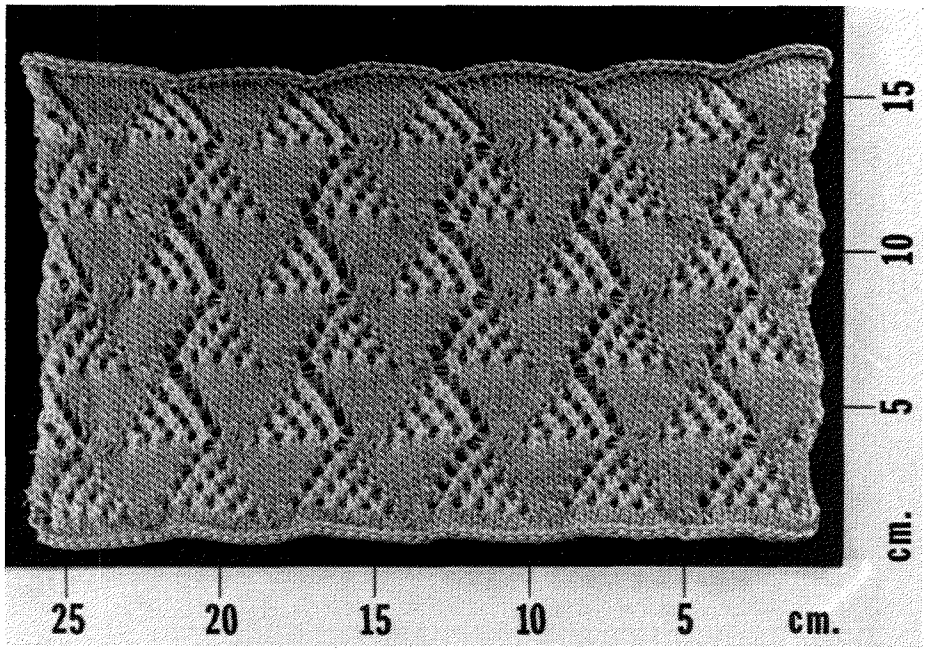
*Pattern 5. Set up the needles as shown. Cast on the MB with col 1 (dark). *Transfer alternate stitches to the needles of the second bed. With col 2, knit 2 rows on the MB stitches, allowing the empty needles to slip. Transfer the stitches from the second bed back to the empty needles of the MB. Knit 2 rows across all stitches on the MB with col 1.* The floats will be on the knit side of the fabric.*

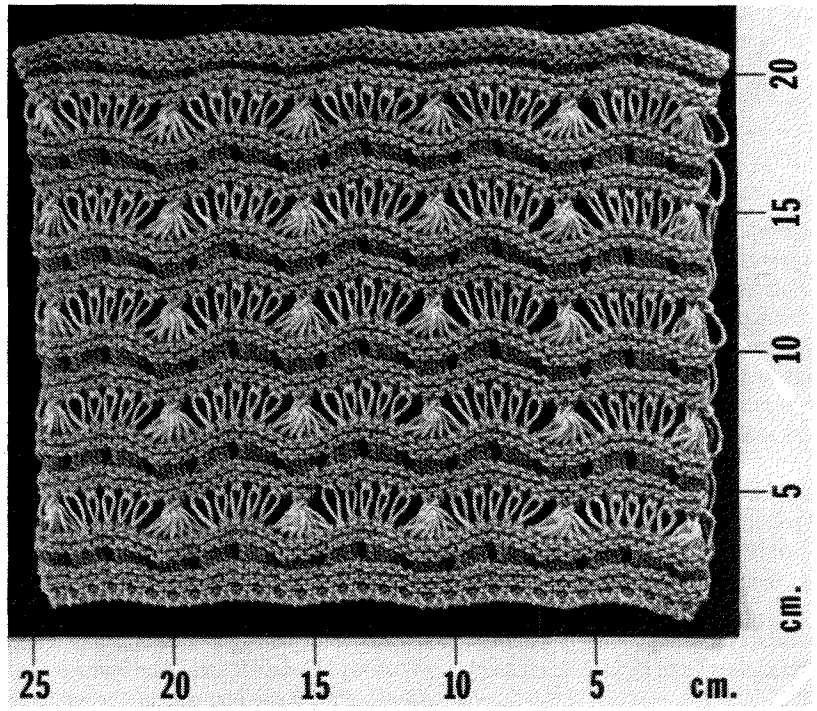
*Pattern 6. Garter stitch brioche fabric. Repeat of 2 rows. *Row 1: knit all stitches; transfer all stitches to opposite bed. Row 2: Knit/tuck 1x1, transfer to original bed.* In the next sequence, change color, and knit/tuck the alternate 1x1 needles.*

Pattern 7. Knit several ribs of garter stitch, plus the first row of the last rib. With a crochet hook, start from the bottom rib and pick up a purl stitch. Pull a purl stitch from the rib above through it, and continue up the fabric in this fashion, hanging the last loop on a needle. Finish the last row of the garter rib.



Lace and cables, an example of intarsia knitting. This example is knitted in comb stitch, one of the multiple transfer patterns given in the Lateral Transfer Lace section of Chapter 14. This fabric is knitted on Brother/Knitking, and here is combined with cables in a second color. The method used for the intarsia is tapestry knitting method 3, found in Chapter 9. It is impractical to use the intarsia carriage for this pattern, because it selects needles for laying in yarn, which means all the stitches must be manually placed in the hooks before the lace carriage can be moved.





Lace and fairisle, a combination of fairisle patterning with lateral transfer lace, made on Brother/Knitking. The "rib jacquard with lace" pattern from the Lateral Transfer Lace section of Chapter 14 here is knitted single bed. It is best to punch another card, like the jacquard card shown, but omit the second and third punched rows for the K carriage color 1 in all the pattern rows. The K carriage is still attached to the belt (KC) with cam set to MC, and the two colors in feeders A and B, as for fairisle.

One of our favorite insertion patterns (also shown in the Drop Stitch Lace section of Chapter 14) is knitted here in two colors, with some additional rows in a third color.

SELECT BIBLIOGRAPHY

This reading list includes books and periodicals which are relevant to all brands of knitting machines.

1. PRIVATELY PUBLISHED BOOKS FOR MACHINE KNITTERS.

These contain general technical information for punchcard knitting machines, and are available through knitting machine dealers.

Kinder, Kathleen.
A Resource Book for Machine Knitters. 1979.
A Second Resource Book for Machine Knitters. 1980.
The Passap Duomatic, Deco and Forma. 1981.
A Resource Book Pattern Supplement. 1983.
The Machine Knitter's Book of the Ribber, Vol. 1. 1984.
The Machine Knitter's Book of the Ribber, Vol. 2. 1985.

Mobuyuki, Tami.
Knitting Machine Workbook No. 1: Basic Techniques. 1977.
Knitting Machine Workbook No. 2: Basic ribber techniques. 1978.
Knitting Machine Workbook No. 3: Patterned knitting techniques. 1984.
Knitting Machine Workbook No. 4: Bulky Knitting Techniques. 1983.

Weaver, Mary.
The Ribbing Attachment, Part 1. 1974.
The Ribbing Attachment, Part 2, 1976.
The Passap Duomatic, 1976.
Machine Knitting Technology and Patterns. 1979.

Most dealers also carry excellent books on specialized subjects, such as electronic knitting, pattern drafting and charting, finishing techniques, and on garment-making patterns and techniques. These are written and published privately by the above and other authors. New titles appear at frequent intervals, and are advertised and reviewed in various knitting machine periodicals.

2. COMMERCIALLY PUBLISHED BOOKS.

These titles are available in general bookstores and libraries.

Davis, Johanna. *Machine Knitting to Suit Your Mood.* London: Pelham Books, 1982.

Gartshore, Linda. *The Machine Knitter's Dictionary.* London: B.T. Batsford, Ltd., 1983.

Holbourne, David. *The Basic Book of Machine Knitting.* New York: Van Nostrand Reinhold, 1978.

Kinder, Kathleen. *Techniques in Machine Knitting.* London: B.T. Batsford, Ltd., 1983.

Lorant, Tessa. *Hand and Machine Knitting.* New York: Charles Scribner's Sons, 1980.

Mendelson, Linda, and Mark Dittrick. *Creative Machine Knitting.* New York: Hawthorn, 1979.

3. HAND KNITTING PATTERN BOOKS

With hand knitting enjoying a renaissance, there is a proliferation of garment and stitch pattern books available, and many are just as useful to machine knitters. Some are new efforts; some are reprints of old favorites. Below is a sampling of titles which concentrate on stitch patterns.

Chatterton, Pauline. *Scandinavian Knitting Designs.* New York: Charles Scribner's Sons, 1977.

Compton, Rae. *The Complete Book of Traditional Knitting.* New York: Charles Scribner's Sons, 1983.

Gottfridsson, Inger, and Ingrid Gottfridsson. *The Swedish Mitten Book.* Asheville: Lark Books, 1984.

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Thomas, Mary. *Mary Thomas's Book of Knitting Patterns.* New York: Dover Publications, Inc.

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Thompson, Gladys. *Patterns for Guernseys, Jerseys and Arans.* New York: Dover Publications, Inc., 1979.

Upitis, Lizbeth. *Latvian Mittens.* Saint Paul: Dos Tejedoras, 1981.

van der Klift-Tellegen, Henriette. *Knitting from the Netherlands.* Asheville: Lark Books, 1985.

Walker, Barbara. *Mosaic Knitting.* New York: Scribners, 1976.

———. *Charted Knitting Designs.* New York: Charles Scribner's Sons, 1972.

———. *A Second Treasury of Knitting Patterns.* New York: Charles Scribner's Sons, 1970.

———————. *A Treasure of Knitting Patterns*. New York: Charles Scribner's Sons, 1968.
Zimmermann, Elizabeth. *Elizabeth Zimmermann's Knitter's Almanac*. New York: Dover Publications, 1981.
———————. *Knitting Without Tears*. New York: Charles Scribner's Sons, 1971.

5. PERIODICALS FOR MACHINE KNITTERS

These publications are available by subscription, and in many yarn shops.

Australian Machine Knitters' Magazine
68 Middleton St.
Watsonia, Victoria 3087
Australia
6 issues per year.

Knitting Machine Digest
Hazel Ratcliffe
142 Frant Road
Thornton Heath, Surrey CR4 7JU
England
6 issues per year.*

Knitting Machine Journal
Alice Wilmshurst
Hawthorne's
Whitecroft, Forest of Dean
Gloucestershire
England

Knitting Machine News and Views
Alles Hutchinson
315 Hamil Road
Verona, PA 15147
11 issues per year.

Machine Knitters Newsletter
130 West 29th Street
New York, NY 10018
6 issues per year.

Macknit: The Machine Knitters Magazine
The Knitting Machine Studio, Inc.
42 Hillside Avenue
Englewood, NJ 07631

Nihon Vogue
Yo's Needlecraft
940 East Dominguez,
Carson, CA 90746
4 issues per year.*

Passap Knitting Machine Journal
Alice Wilmshurst
Hawthorne's
Whitecroft, Forest of Dean
Gloucestershire
England

To & Fro
Jane Anthony
321 Ashley Road
Parkstone, Poole
Dorset, BH14 0AP
England
4 issues per year.*

Western Knitting Machine Guide
P.O. Box 1527
Vashon, WA 98070

* Subscriptions are available through The Knitting Machine Studio Bookshelf, P.O. Box 746, Englewood, NJ 07631.

The periodicals listed below come from the machine manufacturers, and are available at many dealerships.

Brother Fashion
Knitking Magazine
Modern Knitting
The Passap Modelbooks

6. PERIODICALS OF INTEREST TO ALL KNITTERS

These publications are available on newsstands, in yarn shops, and in libraries, as well as by subscription. They contain occasional articles and patterns for machine knitters. They are very inspirational, and are good "idea" magazines.

Burda
Cast On (Publication of The Knitting Guild of America)
Fashion Knitting
Fiberarts
Handmade
Knitters
Schaffhauser
Threads
Vogue Knitting

KNITTING MACHINE DISTRIBUTORS

The following are importers and major distributors of machines in the United States and Canada. If you are looking for a specific brand of knitting machine, a telephone call or letter to the appropriate company will help you find a dealer in your area.

PASSAP

Associated Knitting Machine Co., Inc.
1275 Bloomfield Ave.
Fairfield, NJ 07006
Telephone (201) 575-7047

Bernina Sewing Machine Company, Inc.
70 Orchard Drive
North Salt Lake City, UT 84054
Telephone (801) 298-3882

White Sewing Machine Company
1470 Birchmount Rd.
Scarborough, Ontario
Canada M1P 261

SUPERBA

(Superba machines are now marketed in the United States under the name of White.)

White Sewing Machine Company
11750 Berea Road
Cleveland, OH 44111
Telephone (216) 252-3300

BROTHER

Brother International Corporation
8 Corporate Place
Piscataway, NJ 08854
Telephone (201) 981-0300

KNITKING

Knitking Corporation
1128 Crenshaw Blvd.
Los Angeles, CA 90019
Telephone (213) 938-2077

SINGER

Singer Company
200 St. Louis Street
St-Jean-Sur Richelieu, Quebec
Canada J3B 1Y1
Telephone (514) 348-4921

Singer Company
135 Raritan Center Parkway
Edison, NJ 08837
Telephone (201) 632-6724

STUDIO

Studio Yarn Farms, Inc.
P.O. Box 46017
Seattle, WA 98146
Telephone (206) 763-1310

TOYOTA

Newton's Knits, Inc.
3969 East La Palma
Anaheim, CA 92807
Telephone (714) 632-9861

BOND

The Kimberly Market Corporation
3900 Brinton Place
Charlotte, NC 28211
Telephone (704) 542-6222

AUTO SOCK KNITTER

Harmony Knitters, Inc.
Harmony, ME 04942
Telephone (207) 683-2035

KNITTING MACHINE MANUFACTURERS

As an aid to readers in other English-speaking countries, the manufacturers of the four machines in this book are listed below. These machines are sold throughout the world, but often under different brand names. If you can locate the manufacturer's name on the machine or in the instruction manual, you should be able to deduce which machine in this book is comparable to your machine.

PASSAP

Madag
Poststrasse 45
Dietikon CH-8953
Switzerland

SUPERBA

Superba
13 Rue de Pfastatt
B.P. 2156
Mulhouse 68060
France

BROTHER/KNITKING

Brother Industries Ltd.
359 Chome
Horitadori, Mizukhoku
Nagoya
Japan

SINGER/STUDIO

Silver Seiko Co, Ltd.
16-6 Shinjuku 2 Chome
Shinjuku Ku
Tokyo 160
Japan

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AUTHOR'S NOTE

We are aware that this book won't contain everything every knitter wants or needs to know. Some of the concepts may be new and confusing, and we aren't mistake-proof. if you have questions, suggestions for improvement, corrections, criticisms, praise, new ideas, or would like to tell us how you have used the material in this book, we would love to hear from you! Swatches or photos of your work are welcomed. If you want an answer, or would like swatches or photos returned, please include a self-addressed envelope with appropriate postage, or international reply coupons if you live outside the United States. Please write to us in care of our publisher, at the address shown on the copyright page.

Susanna Lewis is a fiber artist best known for her wearable art and for her expertise as a machine knitter. Her distinctive work is known around the world; it is exhibited at Julie: Artisans' Gallery in New York, and is represented in the permanent collections of The Brooklyn Museum and the Metropolitan Museum of Art.

She teaches machine knitting classes at Parsons School of Design in New York, and has lectured and conducted machine knitting workshops throughout the United States.

Susanna has written extensively on machine and hand knitting, as well as on many other textile topics. Her articles have appeared in scores of craft magazines, and she has contributed to a number of books.

Julia Weissman is a freelance writer and lecturer. She has developed, co-authored, and edited numerous books and magazine articles on a variety of craft subjects. She is an admitted "closet craftperson," and for fifteen years has accumulated a house full of files on crafts which she hopes, someday, to have the time to try.

Other Lark titles of interest to creative people

COLOR-AND-WEAVE DESIGN
A Practical Reference Book
Ann Sutton

THE CRAFT OF THE WEAVER
Peter Collingwood, Ann Sutton, Geraldine St. Aubyn Hubbard

THE FIBERARTS DESIGN BOOK II
edited by Jeane Hutchins

KNITTING FROM THE NETHERLANDS
Traditional Dutch Fishermen's Sweaters
Henriette van der Klift-Tellegen

KNITTING IN THE NORDIC TRADITION
Vibeke Lind

NEW DIRECTIONS IN FAIR ISLE KNITTING
Patty Knox

THE STRUCTURE OF WEAVING
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Ann Sutton and Richard Carr

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